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Introduction

The purpose of this investigation is to evaluate Atlantic coast striped bass stocks and to document the effect that management strategies, imposed upon the coastal striped bass resource, have on the population. Data for these evaluations are acquired through the capture, biological sampling, tagging and release of striped bass. Funds are provided through a grant from the United States Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service. Matching funds are provided by the New York State Department of Environmental Conservation.

The objectives of this investigation are:

1. To provide striped bass biological data to be used in the evaluation and management of this species and to monitor the coastal migratory component of the population;

2. To estimate total annual mortality rates for coastal striped bass;

3. To develop a relative index of abundance for the mixed coastal stocks found on eastern Long Island during the Fall migration;

4. To apply United States Fish and Wildlife Service tags to a sample of the striped bass captured in the ocean haul seine study and to use the release and recapture data to estimate the annual survival rate for the coastal migratory stock.

This report will provide results pertaining to striped bass captured in New York's marine waters for the fall sampling period in 2005, and will provide comparable data from the 1987 through 2004 segments of this investigation.

METHODS AND MATERIALS

A commercial ocean haul seine crew was contracted to set and retrieve an ocean haul seine for the collection of striped bass. Ten locations, known to be free of obstructions, were selected as sampling sites along the Atlantic Ocean beaches between Southampton and Montauk, Long Island, New York (Figure 1). The original locations, identified in 1987 as suitable seine stations, were used for each successive annual segment. Throughout 1987, 1988 and 1989, thirty sampling dates were chosen at random from the available working days for the months of September, October and November. For each date selected, two of the ten stations were chosen at random, without replacement, as the sampling locations for that day. However, the sampling design used since 1990 was altered to reflect the practical nature of sampling in the ocean surf environment. Instead of randomly selecting thirty days from all available working days and assigning two stations for each day, sixty consecutive working days were identified during the fall. One station was randomly selected, without replacement, for each working day until six "rounds" of ten hauls had been scheduled. Hauls which were missed, due to bad weather or equipment failure, were added to the next scheduled sampling day. No more than three hauls were attempted for any given day so that sampling was evenly distributed over time.

Since 1995, the survey team was prohibited from traversing property under the control of the

Trustees of the Commonalty of the towns of East Hampton and Southampton. The issue of cause is New York State's prohibition of the use of the ocean haul seine in the commercial harvest of striped bass. The prohibition effectively kept the survey team from accessing eight of ten standard stations. Two of the standard stations plus three alternate sites have been used since 1995 to complete the annual survey. These alternate stations occur within the range of the original standard stations.

Also since 1995, delays in securing funding have resulted in a one month delay in the commencement of field sampling activities. Between 1987 and 1994 field sampling began in early September. Since 1995, sampling has begun in late September to early October. Also, decreases in funding have led to reductions in annual sampling effort from sixty seine hauls in the 1987 through 1996 seasons to forty-five seine hauls per season since 1997.

The survey seine measures approximately 1,800 feet long and is composed of two wings attached to a centrally located bunt and cod end. The seine is fifteen feet deep in the wings and twenty feet deep in the bunt. The wings are constructed of six inch stretched mesh and the bunt and cod end are constructed of three inch stretched mesh. The lead line is heavily weighted, especially in the mid-quarters and bunt, to keep the net tending bottom given the strength of oceanic currents and wave action. The headrope is outfitted with floats which keep the net upright in the water column. The cod end is outfitted with a quick release mechanism to facilitate prompt removal of the catch for processing.

The seine is set in a semi-circle from a dory powered by an outboard motor. The dory, with the entire seine loaded aboard, is launched into the surf off its' trailer by backing the trailer and dory into the sea with the attached vehicle. Capstan winches, mounted onto the beds of attending pick-up

trucks, are used to haul the net ashore. Department staff assist the haul seine crew in tending the net as it is retrieved.

When three quarters of the net has been retrieved and the bunt and cod end are nearly onshore, the department team set up a temporary holding tank for any striped bass that may be caught. The tank is 4 feet wide, by 4 feet high, by six feet long and holds approximately 400 gallons of seawater. The tank is supplied with running seawater by a centrifugal pump outfitted with reinforced pvc hose. The centrifugal pump is a Jabsco Inc. model 6850-0001 self priming unit powered by a three horsepower Briggs and Stratton gasoline engine. A sand well-point connected to the end of the intake hose prevents sand from fouling the pump. The well-point is held in place by a three pound mushroom anchor. This seawater supply system is a derivation of the type described by Schaefer (1965). While the system is set up and filling the department team can turn their attention back to the progressing seine haul.

When the catch in the cod end becomes visible, a decision is made whether to retain the entire catch of striped bass or to select a sample of the catch. When necessary, systematic sampling of the catch is employed, in which one out of every two to five striped bass in the catch are retained (Cochran, 1953). The degree of sampling is dependent upon the size of the catch. Because our intention is to return every striped bass caught such that it remains alive, we are careful not to wholly sample any large catches. A "large" catch is one considered to be in excess of two hundred striped bass. Since the inception of this investigation in 1987 our decision has been to release any catch we feel is unmanageable. "Unmanageable" catches are those which contain more than one thousand individuals of all species combined.

For each haul the date, location, set time, duration, and time spent processing the catch is

recorded. Various environmental and climatological data are also recorded. These include air and sea temperature, tidal stage, wind direction, wind speed and wave height. Temperatures are measured with a -2 to 30 degree centigrade mercury thermometer. Observations recorded for each striped bass retained include fork length, total length and weight. Fork length and total length are measured to the nearest millimeter. Weight is measured to the nearest .02 kilogram on an A&D Industrial splash proof scale Model FV-60K. A sample of ten to fifteen scales are removed from the left side mid-dorsal region above the lateral line of each specimen, for age determination. Other species of finfish in each catch are identified and counted as time and availability of personnel allows.

Striped bass, judged to be in good condition, are tagged with internal anchor tag prior to release. Internal anchor tags, supplied by the United States Fish and Wildlife Service, are placed into striped bass according to guidelines established by the Emergency Striped Bass Study Coast wide Tagging Procedures. The tag is inserted approximately one inch posterior from the smoothed back tip of the pectoral fin, on the left side of the fish. The tag is placed into the body cavity of the fish by removing a few scales and making a slight incision to the depth of, but not through, the peritoneum. The anchor is then gently pushed through the peritoneum, into the body cavity, and "set" by tugging on the protruding streamer. The tag is placed such that the external streamer does not interfere with, nor abrade, the area surrounding the vent and anal fin. No topical antiseptics are used to treat the incision wound since all specimens are returned to a marine environment (i.e. salinity > 10 ppt.). The plastic tag anchor is 3 centimeters long by 1 centimeter wide, and the attached streamer is 10 centimeters long. The tag legend, printed on both the anchor and streamer, provides identification and telephone numbers for the purposes of reporting recaptures. Appearance

of the legend on both portions of the tag provides for multiple reporting possibilities of the recapture of a single specimen. A telephone number printed on the tag directs all respondents to the U.S.F.W.S. coordination office in Annapolis, Maryland. Researchers at the coordination office have compiled a master database of coast wide tag releases and recaptures for analysis. The U.S.F.W.S. provides participating agencies with reports of tag numbers and associated data from recaptured striped bass.

Beginning in 1991, each striped bass retained for sampling was scanned for the presence of magnetic coded-wire tags using the Northwest Marine Technologies wand type tag detector, provided by the U.S.F.W.S. Striped bass which scan positive for coded-wire tags are sacrificed for later removal and identification of the tag. Scanning was not conducted during the 2000 sampling season due to the lack of a scanning wand. Scanning for coded-wire tags was discontinued after the 2004 survey due to the low incidence (absence) of CWT recaptures for several seasons.

Field data, originally recorded on scale collection envelopes, are transferred onto computer files. The computer database is error checked by comparing randomly selected records to the original field data. Database records of tagged and released striped bass are provided to the U.S.F.W.S. coordination office for inclusion into the coast wide tag database.

Scale samples are returned to the laboratory where scale impressions are made into GG grade, 0.05 inch, clear cellulose acetate using a Carver Model C, heated laboratory press. Scale impressions are created on 6 inch by 5 inch acetate plates by arranging the scales collected in separate 1 inch by 3 inch slides scored into the acetate plates. The acetate is then sandwiched between two metal pressing plates and placed into the laboratory press which has been preheated to 170 degrees Fahrenheit. The sample plate is then pressed for five minutes at fifteen to twenty thousand pounds

pressure as indicated by the pressure gauge on the laboratory press. When pressing is complete, the scales are replaced into their respective sample envelopes and the acetate plate is cut into 1 inch by 3 inch slides. The slides are placed into microscope slide boxes in batches of one hundred. Scale impressions are viewed on either an Eberbach slide viewer, a Northwest Microfilm Microfiche reader or a binocular microscope. Each sample is evaluated independently by two readers, and assigned ages are compared for agreement. Samples for which age cannot be resolved by a group reading or by a repress of the sample are rejected.

RESULTS

Forty seine hauls were completed in 2005. The total catch was estimated to be 9,579 striped bass. Biological samples were collected from 1,039 striped bass and 986 of those sampled were tagged with internal anchor tags and released. Six striped bass bearing previously applied tags were caught, one American Littoral Society (ALS) tag , and five USFWS tagged fish.

Over the nineteen year sequence of this investigation a total of 170,699 striped bass have been captured; 30,422 of those have been sampled; and 26,485 of those sampled have been tagged (Table 1).

The total catch of striped bass was estimated for eleven hauls completed during 2005. In each, the total catch was too large to be systematically sampled and was immediately opened in the surf. Each estimated catch was calculated by dividing an estimate of the weight of the total catch by the mean weight of striped bass which were retained in the net after the bulk of the catch had been released. This method has been used since the inception of this program to estimate the catch of very

large ("unmanageable") catches.

Table 2 provides a summary of the mean catch per haul of striped bass for standard hauls completed between October 2 through November 29 each year from 1987 - 2005. The geometric mean catch of striped bass for the 2005 survey was 51. The highest mean catch was observed in 1996 and the lowest in 1989 with 162 and 12 striped bass per haul, respectively. In general, mean catch of striped bass in the ocean haul seine survey increases three to four years after strong recruitment events occur (Schaefer, 1968). For example, mean catch increased as the 1993 cohort recruited to the coastal migratory stocks in 1996; again as the 1996 cohort recruited in 2000; and recently as the 2001 cohort recruited in 2004. Further discussion of these implications can be found in the catch at age section of this report.

Concern over the scientific continuity of the survey data due to the prohibition of the survey team from accessing all ten standard stations prompted a review of the catch data. Since the replacement stations were not sampled throughout the time series, no direct comparison of catch from these stations to the catch from all standard stations could be made. Instead, the mean catch by year from three standard stations which bracket the replacement stations was compared to the mean catch by year from all standard stations for the years when the survey team had access to all standard stations. Mean catch by year was calculated for stations 2, 3 & 4 and separately for all ten standard stations. For each year (1987 - 1994), the difference between mean catch was tested to determine if the differences were significantly different from zero. The mean difference in mean catch was negative (-21.8) and the probability of the difference occurring by chance was .1752. Further, the slopes of regressions fit to the natural log of mean catch by year for both data sets were not significantly different. We conclude that there was no affect on the integrity of the time series

since the mean catch between the full data set and the subset of stations, although lower in magnitude, was not significantly different from zero. Neither were the regression slopes found to be significantly different from one another suggesting that any trends observed in the data were not corrupted by the survey being forced to sample only a portion of the usual geographic area.

A second issue of concern arose regarding delays in the start of sampling. Between 1987 and 1994 the first sampling day occurred between September 1 and September 18. Since 1995, the first day of sampling has ranged between September 24 and October 2. In effect, all September sampling was missed from 1995 through 1999.

A procedure similar to the one previously described was performed to determine if the delay in the start of sampling had an effect on the catch indices which resulted between 1987 and 1994, the period during which September sampling was accomplished. First, it was established that the first sampling day common to all years across the period of 1987 to 1998, was October 2. Each year the survey concluded within the first week of December. Mean catch was standardized by date using hauls beginning on October 2 and ending with the last seine haul each year for the period of 1987 to 1994. The geometric mean catch for standardized data was compared to the non-standardized data by t-test (Cody and Smith, 1991). The mean difference in mean catch was positive (2.19, $p = 0.3198$). Although the standardized indices yielded slightly higher results, the mean difference was not significantly different from zero. A similar approach based on standardized sea temperature resulted in a mean difference of 25.01 and was also found not significant ($p = 0.3090$).

The analysis was repeated with the data subset by age. No significant differences were found, by age, for the sea temperature standard indices. Differences were found, however, for the date standard indices at ages two ($p=0.0344$), seven ($p=0.0105$), eight ($p=0.0117$), nine ($p=0.0088$), and

ten (p=0.0184). For age two striped bass, the mean difference was positive (0.94). Removal of the September hauls resulted in standardized indices which were significantly higher, indicating that more two year old fish were caught later in the survey during 1987 through 1994. Conversely, for ages seven through ten, the mean differences were negative (-0.26, -0.18, -0.14, and -0.08, respectively). Removal of the September hauls resulted in standardized indices which were lower, indicating that fewer age seven through ten fish were caught later in the survey during 1987 through 1994.

These results suggest that the time series of catch at age should be standardized by date. The delay in the start of sampling has had an appreciable effect on the estimated abundance at age. Henceforth, catch data contained in this report will be reported for hauls made on those standard dates between October 2, and November 29, unless otherwise noted.

STRIPED BASS LENGTH DATA

Total length frequencies of striped bass by year are presented on Table 3. The length distribution of each systematically sampled or estimated haul was expanded so that the total catch is represented. In 2005, the total length of striped bass observed ranged from 346mm to 1,211mm. Mean total length of the sampled catch was 532mm. The largest and smallest striped bass ever observed in this survey were captured during 1988. Those individuals were 1,336mm and 272mm, respectively.

Five, fifty millimeter length intervals from 400mm to 650mm inclusive, dominated the 2005 total length frequency distribution of striped bass (Table 3). In summary, these intervals accounted

for 90% of the 2005 catch. The slot of dominant size intervals (i.e. those contributing >10% each to the frequency distribution) has varied within the range of 400mm to 750mm since the survey began in 1987. Total Length frequency as depicted on Figure 3 demonstrates the shift which has occurred in the abundance and size distribution of coastal striped bass stocks, as observed in this survey between 1987 and 2005. These observed changes have occurred as a result of the recruitment of strong year classes to the coastal mixed-stock striped bass population.

Mean catch per length interval (Table 4) shows the change in size distribution over time from dominance of larger to smaller sizes as strong cohorts recruited to the coast during the early and late 1990's.

The functional relationship between fork length and total length was examined by least squares regression of the log transformed length measurements (Ricker, 1973). The geometric mean estimate of the regression of total length (LnTL) on fork length (LnFL) was highly significant with $R^2 = .9757$ ($p<0.0001$). The resulting equation from all fish across all years was:

$$(1) \qquad LnTL = (LnFL)(0.962) + 0.308$$

and was derived from 29,728 paired observations of length over the history of the survey. The reciprocal relationship was also examined yielding the following regression equation:

$$(2) \qquad LnFL = (LnTL)(1.01) - 0.161$$

which was also highly significant with the same coefficient of determination and degrees of freedom as the LnTL predictive equation.

STRIPED BASS AGE DATA

Age frequency distributions of striped bass captured on standard survey dates between 1987 and 2005 are presented on Table 5 and Figure 4. Those hauls in which the total catch was sampled or estimated were expanded to approximate the age distribution of the catch in the same manner as described for total length.

Striped bass from the 2005 survey ranged from age two to age sixteen. Ages two, four and five striped bass dominated the 2005 catch. Together, these cohorts constituted 85% of the catch in the 2005 survey. Age three striped bass, the 2001 cohort, accounted for 42% of the catch, and was the most dominant cohort observed in 2005. In ten out of the last nineteen years of the survey, the most dominant cohort was age three. However, the 1993 cohort dominated the catch in consecutive years at ages 2, 3, 4, and 5, evidence that this was a significantly strong recruitment event.

Table 6, mean catch at age, indicates that age four fish (the 2001 cohort, and highest in abundance during the 2005 survey), also dominated the catch at age 3 during the 2004 survey. The 1993 year class, one of the strongest baywide striped bass indices ever observed in the Chesapeake Bay (G.M.= 13.97; G.M. average = 4.12) (Hornick, et. al, 2002), only ranked fourteenth highest in abundance in the Hudson River time series of juvenile production from 1980 through 2002 (Brischler, 2004), yet dominated the ocean haul seine survey catch at ages 2, 3, 4, and 5 during the 1995 through 1998 survey years. Currently the most abundant cohort, the 2001 cohort (age 4 in 2005) was more than three times the average of Chesapeake Bay-wide juvenile indices observed between 1959-2002, and ranked 3rd highest of the annual indices measured for the six week juvenile survey conducted in the Hudson River between 1980-2004 (Hornick, et. al, 2002; Socrates, 2005).

STRIPED BASS LENGTH AND WEIGHT AT AGE

Mean total length by yearclass for all fish captured during the 2005 survey is provided on Table 7, and Figure 5. Mean total length by yearclass, summarized for 1987 through 2005, is provided on Table 8.

Mean weight of striped bass by cohort is provided on Table 9, and Figure 6 for the 2005 survey. Mean weight by cohort is summarized by year on Table 10 for the entire time series from 1987 through 2005.

Mean total length and mean weight at age are provided, for all striped bass observed over the entire time series, on Tables 11 and 12 as well as on Figure 7.

Table 13 provides annual growth increments of total length (13.A.) and weight (13.B.) by age for various cohorts of striped bass observed over the time series. Mean growth increment in total length and weight by age is plotted on Figure 8, indicating that the growth increment in total length decreases, while the growth increment in weight increases, between years as striped bass progress in age.

The functional relationship between weight and total length was examined by least squares regression of the log transformed variables. The geometric mean estimate of the regression of weight (LnWT) on total length (LnTL) was highly significant with $R^2 = .98$ ($p < 0.0001$). The resulting equation is:

$$\text{LnWT} = (\text{LnTL})(2.92) - 17.938 \quad (3)$$

and was derived from 29,588 paired observations of weight (Kg.)and total length (mm) collected over the history of the survey. The most recent year specific regression of weight (LnWT) on total

length (LnTL) was highly significant with $R^2 = .98$ ($p < 0.0001$). The resulting equation is:

$$(4) \qquad LnWT = (LnTL)(2.86) - 17.54$$

and was derived from 1,033 paired observations of weight (Kg.)and total length (mm) collected during 2005.

Table 14 provides a summary of parameters for regression of $\log_e$ (weight) on $\log_e$ (length) for each year from 1987 to 2005. Parameter estimates, and standard errors of slopes and intercepts of $\log_e$-transformed weight and $\log_e$-transformed length varied slightly, but without trend throughout the time period, and did not indicate any trend in weight/length relationship. The variability of the weight/length relationship was stable over the time period (i.e., $R^2 >= .93$ for 1987-2005).

While standard regression techniques seemed to indicate that there are little or no differences in the length, weight and age relationship between years, differences in weight/length; weight/age, and length/age relationships for different years were found from standard covariance analysis (Vecchio et. al., 2003). Whether or not these differences are related to increased abundance, or the introduction of ageing error, will probably remain a subject of debate. However, these results suggest that year specific relationships between weight, length, and age be utilized in the annual stock assessment, since differences have been detected between years.

CATCH PER UNIT OF EFFORT AND MORTALITY

Two objectives of this investigation are to develop indices of adult stock abundance, and to use those indices to estimate the total annual mortality rate for coastal striped bass. Catch data resulting from this survey provide estimates of the population age structure and allow the calculation

of total annual mortality for specific year classes. Catch per unit of effort (CPUE) can be used as an indicator of abundance specific to each year class in the coastal striped bass stock. Mean CPUE is calculated by dividing the total catch of each cohort by the total number of seine hauls. The resulting mean CPUE is a total ratio estimator of the abundance of striped bass expressed on a per haul basis (Nielsen, 1983). These estimators of abundance may be used for calculating mortality specific to each year class. The slope of a line fit through each annual CPUE, after log transformation, is an estimate of the total annual mortality (Z) for that cohort. The relationship between mortality (Z) and survival (S) is defined as;

$$S=e^{-z}$$

and permits ready translation between these two population parameters. The method of "cohort analysis", that is, following the abundance of a single cohort over time, is appropriate to estimate mortality for striped bass due to the high variability of year class production observed in this species (Ricker, 1975). By tracking new cohorts into each set of annual survey data we can determine the age at which each cohort is fully recruited to the coastal population and the ocean haul seine gear. This determination is important in the consideration of mortality. A cohort must be fully recruited to the population, as well as the sampling gear, before the method of cohort analysis is appropriate for use.

Catch curves were examined for the 1980 through 1998 year classes observed in the catch between 1987 and 2005. Abundance estimates (standardized geometric mean CPUE) were used between years which followed the first year of peak recruitment and adequate sample sizes of older fish (Table 15). The CPUE data was standardized by date across survey years due to the significance

of the absence of September sampling in recent years. Least square methods (GLM) were used to estimate regression parameters of a separate-slopes model (SAS, 1986). The dependent variable (Y) was set $Y = [\log_e (\text{mean cpue})]$ and X = sampling year. Indicator variables were defined as each year class included in the separate slopes model. Estimates of total mortality for each of the year classes examined are provided on Table 16. Total mortality (Z) estimates ranged from 0.356 for the 1980 year class to 0.780 for the 1996 year class. In general, mortality estimates were consistently higher among recent cohorts (since 1993), however the standard error of Z tended to be higher as well. Ignoring year class, a common slope model yielded a Z=0.49 (S.E.(Z) = 0.02) for the 1980 to 1998 cohorts, ages 7 through 15 in 2005.

For those year classes with abundance estimates spanning the 2005 survey (the 1998 - 1988 cohorts, ages 7 to 17), mortality (Z) estimates ranged from 0.412 to 0.780. The weighted mean mortality (weighting by inverse precision) among these cohorts was Z = 0.59, or fishing mortality of F = 0.44, assuming that natural mortality (M) equals 0.15.

U.S.F.W.S. TAG RELEASES AND RECOVERIES

Since 1987, striped bass have been tagged during the fall L.I. Ocean Haul Seine Survey using internal anchor tags provided by the United States Fish and Wildlife Service (U.S.F.W.S.). Tags are inserted according to the coastal tagging procedures guidelines. Other Atlantic coast State agencies collect similar data and apply the U.S.F.W.S. tag to striped bass captured by their respective sampling programs. Tag release and recapture records are exchanged between participating agencies and the U.S.F.W.S. coordination office in Annapolis, Maryland. The incorporation of all tag release

data into the U.S.F.W.S. coastal striped bass tagging database, centralizes the release and recapture information which helps scientists analyzing the data provide estimates of critical population parameters on a population level.

This section will describe the size and age distribution of the 2005 tag releases and summarize all recaptures to date by gear, state, disposition and type of recapturing fisherman.

During 2005, nine hundred and eighty six (986) striped bass were tagged and released into the Atlantic Ocean off the south shore of Long Island. Table 17 provides the total length and age distribution of these releases. The smallest fish tagged was 346mm, while the largest fish tagged was 1,211mm. Seventy-seven percent of the striped bass tagged were within 400mm to 600mm. Ages ranged from two to sixteen. Ninety-two (92) percent of the striped bass tagged were among ages two through five.

Table 18 provides the total number of releases from 1987 to present and the number of recaptures through May of 2006 for all fish tagged during the survey. Table 19 provides the number of releases and recaptures for those fish greater than twenty-eight inches in total length at the time of release. With the addition of the 2005 tag releases a total of 26,486 striped bass have been tagged and released over the nineteen year sequence of this survey. To date 4,534 (17%) tags have been recaptured. Higher proportions of tag recaptures have occurred for those tag cohorts at large over several years (Tables 18 and 19).

Table 20 describes the distribution of recaptures by gear, State, type of fisherman and disposition of the fish. The greatest proportion of recaptures have occurred by hook and line gear (89%) followed by gillnet (4.5%). The greatest proportions of recaptures have occurred in New York (39%), Massachusetts (19%) and New Jersey (165%). The majority of reported recaptures (91%)

have occurred between Maine and New Jersey, inclusive. The majority of recapturing fishermen were indicated as sport fishers (80%). Commercial fishers (9%), Charter (5%), Researchers (3%) Market (1%), and Other (1%) comprised the remainder of the recapturing types. The majority of recaptures were reported as released (63%) or consumed (30.8%), while the remainder were sold (4.0%), found dead (0.5%), accidentally killed (0.8%), or sacrificed for research purposes (0.1%). In some cases, only the tag was found (0.5%), so no disposition of the fish is known. The proportion of recaptures which were subsequently released alive has been declining, from about 94%, in the early years of tag recoveries, to about 65% in the most recent full year of recoveries (2005).

TAG RECOVERY ESTIMATES OF SURVIVAL

Through 1996, mark/recapture based estimates of survival were calculated using methods described by Brownie et. al. (1985) and computer program PC SURVIV. In computer program SURVIV, stepwise reduction of model parameters, combined with likelihood ratio tests between models, assists in selecting the "best" model fit to the release/recovery data. As mark/recapture theory on this subject evolved new computer software became available, and program SURVIV was superseded by program MARK (White and Burnham,1997). Program MARK represents an improvement in the estimation of tag based survival because MARK is suited to providing parameter estimates when the complexity of tag models is increased due to increasing numbers of release/recapture intervals or groups (age, stock, sex). Program MARK estimates model parameters based on maximum likelihood methods. The number of estimable parameters and their likelihood

is then used to calculate a statistic called the Akaike information criteria (AICc) for each model (Akaike, 1985). The AICc (AICc index) measures the difference between an individual model and a hypothetical "true" model. The smaller the AICc, the closer the selected model is to the "truth". In the parameter estimation process, a set of candidate models are identified, *a priori* ,and each model is fit to the mark/recapture data. Since each candidate model has been accepted as a biologically plausible model, the results from all models are averaged into the final estimate of survival, weighted by their AICc. In the weighting scheme, the models which are closest to the "truth" (i.e., have the lowest AICc) receive the greatest weight. In this way, no single model is selected, as was done under PC SURVIV, rather the survival estimate is a mean of several plausible models, weighted by the AICc of each. These procedures represent a significant departure from previous methodology wherein a single, "best", model was chosen. The current procedure is thought to be more robust since uncertainty associated with model selection is eliminated by use of all models in the weighting procedure.

Fit of the global model is evaluated by examining the goodness-of-fit through parametric bootstrap procedures provided in MARK. The details of the numerical procedures are available in the software documentation.

Table 21 provides the selected tag models fit to the data of all striped bass tag releases and their recaptures. In the model designations (t) stands for time dependence, (.) signifies a constant effect, (d), (v) or (p) signifies periods of consistent regulatory. The models in table 21 are arranged by order of their fit (Delta QAICc), with the best fitting model first. The results show the global model (S(t)r(t)) as having the best fit and acquiring 100% of the weight in the final model-weighted survival estimates. However, goodness-of-fit testing indicates that the global model performs poorly

hence the resulting survival estimates for the all fish group provided in Tables 22, and 25 should be viewed with caution.

Table 22 provides annual survival estimates which result from the model weighting process. The 2005 weighted mean survival estimate for all striped bass was 0.564. However, as noted, the model goodness-of-fit for these data was poor and these results should be viewed with caution. One possible cause for the lack of fit is over-dispersion in the recapture data, arising as a result of behavioral differences among the wide variety of ages included in the "all fish" group. It is possible that assumptions related to equality of recapture fates are violated due to the behavior of young versus older fish among those tagged.

Another iteration of tag based survival estimation is for those striped bass tagged at sizes greater than or equal to 28 inches total length. These models are believed to represent survival of fish which are fully recruited into the coast-wide fisheries . Table 23 provides the set of candidate models and the resultant model statistics. Goodness-of-fit testing indicates that the global model fits reasonably well (p=0.122 for 500 simulation bootstraps). The results suggest an influence of regulatory action on the recovery parameter, as these models garnered the highest weight among the suite of models analyzed. Table 24 provides the survival estimates which result from model weighting. The 2005 weighted mean survival estimate for striped bass greater than or equal to 28 inches total length was 0.793 (s.e. = 0.08) In contrast to the all fish group, these results can be viewed with greater confidence given the outcome of the goodness-of-fit testing.

The advent of program MARK also revealed a potential bias in survival estimates resulting from the live release of striped bass after their tags had been cut off. This bias was assessed by Smith et. al. (2000) who proposed a formula for calculating survival estimates from mark/recapture

experiments adjusted for the live release bias. Following the method of Smith et. al., Table 25 provides bias-adjusted survival estimates for all striped bass tagged. Table 26 provides bias-adjusted survival estimates for striped bass greater than or equal to 28 inches total length at the time of release. In all cases the bias is negative resulting in a higher survival rate than originally estimated. This follows from the reasoning that some portion of recaptured fish are released alive after the angler has removed the attached tag. For 2005, the adjusted survival in the all fish category was 0.621, resulting in an adjusted fishing mortality (F) equal to 0.33 assuming a natural mortality rate of 0.15. Again, these results should be viewed with caution given the outcome of the goodness-of-fit testing which showed poor fit of the global model for this group. For striped bass greater than 28 inches, the adjusted survival was 0.854, or an F of 0.01, assuming natural mortality of 0.15.

Uncertainty associated with the live release bias adjustment, and hence with these reported fishing mortality rates, involves the need for an appropriate reporting rate for recovered tags, as well as appropriate natural mortality, and catch/release mortality rates. In the current analysis, a reporting rate of 0.43 was used based on results of a high reward mark/recapture study performed in Delaware Bay. Instantaneous natural mortality was assumed to be 0.15, and catch/release mortality was assumed to be 8%. Considering the decreasing trend in the proportion of recaptures which are subsequently released alive, and the uncertainty associated with the other parameters, perhaps the need to calculate an exact bias adjustment is moot.

MAGNETIC CODED WIRE TAG HATCHERY RECAPTURES

Between 1983 and 1995 approximately 12.3 million hatchery reared striped bass were

released into Atlantic coastal waters from Maine to North Carolina (Upton, 1994). Prior to release, the fish were tagged with binary coded wire tags (CWT). Screening of captured striped bass for the presence of CWT began during the 1991 L.I. ocean haul seine survey. During 2003, one CWT tagged striped bass was recovered out of the 841 fish scanned. Scanning for CWT was discontinued thereafter as the population of CWT tagged hatchery fish declined.

Total length and year class distributions of the hatchery recaptures for 1991 through 2001 are provided in tables 27, and 28. During the 1997 survey, the largest hatchery fish recaptured to date (1,011mm) was caught, which originated from Edenton hatchery releases in the Choptank River, MD during 1988. Prior to 1997, the largest hatchery recovery (1,003mm) was observed in 1995.

The oldest hatchery specimen recovered to date (age 12) was recaptured during 1996. This fish originated from the Verplank hatchery located on the Hudson River in 1984.

Table 29 provides the distribution of hatchery recaptures by river and hatchery of origin. The majority of hatchery recaptures recovered in the survey were released in the Patuxent River or the Upper Bay region of the Chesapeake Bay and originated from the Pepco or Senecaville hatcheries.

EXAMINATION OF SCALE METHOD FOR AGEING STRIPED BASS

Several authors have commented on the need for fisheries researchers to validate the means by which they estimate the age of fish among their respective sampling programs (Beamish and McFarlane, 1983). The 1996 SARC report on the review of the striped bass virtual population analysis (SARC, December, 1997) identified the use of scales, rather than otoliths, as a source of uncertainty and recommended that "further study be done on the discrepancy in ages between scale

ages and otolith based ages."

Beamish and McFarlane (1983), who likened validation of the ageing technique to the calibration of instruments in other fields of science, distinguished two basic types of validation methodologies. The first apply to all age groups and include the use of mark-recapture studies or the capture of known-age fish. The second, which applies to only the youngest life stage (ie. fastest growing) of a species, include analysis of length frequency, the comparison of multiple structures (ie, otoliths, scales, fin rays), back-calculation of length, as well as others. Here, we attempt to validate the use of scales for aging striped bass through the recapture of known-age hatchery fish. During the Fall survey, two hundred and fifty- five (255) CWT recaptures were collected between 1991 and 2001 (Table 30). Scales were removed, prepared, and ages were assigned by methods previously described. Scale ageing was completed prior to our receipt of the coded wire tag information from the U.S.F.W.S. examiner. Eighty-seven percent agreement (222/255) between the scales and known ages was observed (Table 30). Of the 33 errors, 30 (91%) were all within one year of the known-age of the specimen. One, age four CWT, and one age eight CWT, were under-aged by two years; while one, age six CWT, was under-aged by three years. Errors in aging were found for ages three through nine, and eleven. No errors were found for scales from hatchery recaptures age 2, 10 and 12 although very few age 8 and older CWT recaptures were collected. It is worthwhile noting that these results are not based on age assignments by individual readers. Rather, these results reflect the accuracy of the group process as discussed in earlier sections of this report.

Figure 9 describes the pattern of agreement between scales, and known ages. Overall, these results suggest that ageing striped bass by the scale method provides age determinations with an approximate 10% error rate.

DISCUSSION

The adaptive approach instituted for management of the Atlantic coast striped bass stock utilizes various population characteristics as the fundamental indicators of present and future striped bass stock health. Changes in these indicators may result in the adoption of more or less restrictive management measures to suit the goals of the Fisheries Management Plan (FMP) for striped bass. The FMP, therefore, recommends continuous stock monitoring so that management policies remain consistent with the most recent information available. The Long Island Ocean Haul Seine Survey provides data concerning the size and age composition, growth, abundance and mortality of coastal migratory striped bass, as well as tag recovery estimates of survival.

The protection afforded to striped bass under the FMP has preserved increasing numbers of adults for spawning which may well have assisted in improved production of juveniles and hence the increase in recruits and growth in stock as noted in this survey. Careful management of the coastal striped bass population will allow the goal of the FMP, "To perpetuate, through cooperative interstate fishery management, migratory stocks of striped bass so as to allow a commercial and recreational harvest consistent with the long term maintenance of self-sustaining spawning stocks and to provide for the restoration and maintenance of their essential habitat", to be achieved (A.S.M.F.C., 1995). The collection of biological data required to effectively monitor the status of the striped bass population and the effects of management relative to this goal, is the important contribution the Long Island Ocean Haul Seine Survey makes to the overall management of the species.

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Table 1. LI Ocean Haul Seine Survey Annual Summary of Striped Bass Sampling.

Year	Total Catch	Number Sampled	Number Tagged	Number of Hauls
1987	3,812	1,953	1,741	56
1988	2,892	2,110	1,869	59
1989	1,248	1,196	947	60
1990	4,586	2,043	1,117	59
1991	9,771	1,795	1,093	60
1992	4,918	1,612	1,376	60
1993	3,118	2,217	1,920	60
1994	5,693	1,718	1,611	60
1995	7,010	1,496	1,385	60
1996	15,884	2,266	1,905	55
1997	25,508	1,752	1,691	48
1998	26,893	1,615	1,547	45
1999	3,735	1,421	1,353	45
2000	9,758	1,527	1,485	45
2001	6,322	1,068	1,027	45
2002	7,123	1,226	1,188	45
2003	11,286	841	801	27
2004	11,563	1,527	1,443	45
2005	9,579	1,039	986	40
Total	170,699	30,422	26,485	974

Table 2. Long Island Ocean Haul Seine Survey Striped Bass Catch Data from 1987 to 2005. Geometric Mean Catch and associated Statistics for Hauls made between October 2 through November 29 of each year.

Year	No.# Hauls	G.M. CPUE	Var	Std	LCLM	UCLM	C.V.
1987	35	43	3.5	2.4	28	67	32.3
1988	38	35	2.1	1.9	25	51	29.8
1989	42	12	2.5	2.1	8	18	43.7
1990	35	31	20.7	4.8	17	58	50.6
1991	45	25	82.4	7.2	13	48	64.4
1992	35	19	18.3	4.6	10	36	57.1
1993	37	26	2.3	2.0	18	38	32.9
1994	32	17	5.5	2.9	10	29	47.2
1995	44	16	19.2	4.7	9	28	60.8
1996	40	162	11.0	3.8	98	269	30.9
1997	41	126	213.4	9.1	60	262	47.8
1998	31	148	105.1	7.7	66	327	43.2
1999	30	30	8.0	3.4	17	54	43.0
2000	42	78	8.3	3.5	48	125	34.2
2001	36	32	10.8	3.8	18	55	45.1
2002	37	24	29.6	5.4	13	46	57.2
2003	26	69	67	7	30	160	48.3
2004	41	131	6	3	84	203	28.3
2005	40	51	23	5	28	90	45.2

Table 3. Long Island Ocean Haul Seine Survey Striped Bass Total Length Frequencies 1987 - 2005. Subsampled Hauls Expanded to Approximate the Distribution of the Total Catch. Data for Hauls made between 10/2 through 11/29.

TL	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
249	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
299	0	13	0	14	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
349	13	30	10	187	0	1	0	0	193	22	23	4	0	1	0	1	0	0	1
399	20	67	41	610	97	16	8	2	2382	632	1053	672	12	98	3	143	30	177	280
449	68	172	60	329	1233	181	132	80	2305	5223	4624	3550	329	512	202	2269	718	1876	1764
499	119	344	120	405	2366	726	441	667	596	4812	8972	3968	874	809	1021	2073	2067	3069	1562
549	166	281	145	696	2159	1155	491	547	301	2526	7244	5047	1197	1802	2767	818	3588	2919	1931
599	391	358	134	593	1631	1347	284	702	309	1036	2277	6258	420	2829	1091	456	1494	1676	2245
649	948	361	81	554	613	567	146	520	171	710	420	4683	182	1535	460	187	1006	946	1159
699	738	325	92	294	331	193	54	276	70	427	381	1600	69	940	201	283	778	341	258
749	460	194	91	142	113	79	17	91	27	107	43	382	7	298	37	219	780	189	207
799	153	90	50	101	119	34	13	203	25	72	69	53	7	349	54	107	284	120	46
849	43	44	31	52	111	19	13	75	60	55	8	122	1	235	20	183	198	125	30
899	29	15	22	38	85	18	9	32	11	46	32	9	5	153	10	27	207	34	21
949	5	12	10	17	72	16	22	21	14	4	18	3	8	45	11	8	116	78	49
999	2	2	0	5	29	19	17	17	8	1	27	27	3	45	3	14	10	6	12
1049	0	1	1	2	27	4	7	14	8	8	24	3	2	75	0	2	9	2	1
1099	2	5	2	0	26	3	2	10	5	0	4	5	8	4	0	2	2	0	12
>1099	6	25	7	4	40	11	12	12	4	3	2	0	2	29	5	1	0	3	3

Table 4. Long Island Ocean Haul Seine Survey Striped Bass Mean Catch Per Haul by Total Length Interval for 1987 - 2005. Data from Standard Hauls made Between 10/2 Through 11/29.

TL	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
249	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
299	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
349	0	1	0	5	0	0	0	0	4	1	1	0	0	0	0	0	0	0	0
399	1	2	1	17	2	0	0	0	54	16	26	21	0	2	0	4	1	4	7
449	2	5	1	9	28	5	4	3	52	131	113	111	11	11	6	61	28	45	44
499	3	9	3	12	54	21	12	21	14	120	219	124	29	18	28	56	79	73	39
549	5	7	3	20	49	33	13	17	7	63	177	158	40	40	77	22	138	70	48
599	11	9	3	17	37	38	8	22	7	26	56	196	14	63	30	12	57	40	56
649	27	9	2	16	14	16	4	16	4	18	10	146	6	34	13	5	39	23	29
699	21	9	2	8	8	6	1	9	2	11	9	50	2	21	6	8	30	8	6
749	13	5	2	4	3	2	0	3	1	3	1	12	0	7	1	6	30	4	5
799	4	2	1	3	3	1	0	6	1	2	2	2	0	8	1	3	11	3	1
849	1	1	1	1	3	1	0	2	1	1	0	4	0	5	1	5	8	3	1
899	1	0	1	1	2	1	0	1	0	1	1	0	0	3	0	1	8	1	1
949	0	0	0	0	2	0	1	1	0	0	0	0	0	1	0	0	4	2	1
999	0	0	0	0	1	1	0	1	0	0	1	1	0	1	0	0	0	0	0
1049	0	0	0	0	1	0	0	0	0	0	1	0	0	2	0	0	0	0	0
1099	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>1099	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0

Table 5. Long Island Ocean Haul Seine Survey Striped Bass Age Frequencies 1987 - 2005. Subsampled Hauls Expanded to Approximate the Distribution of the Total Catch. Data from Standard Hauls made Between 10/2 Through 11/29.

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	12	48	7	0	0	0	0	3	6	15	40	0	0	1	0	9	0	0	0
2	108	564	207	150	3383	257	275	420	4968	1489	6330	4812	229	1127	227	3541	1452	874	2868
3	431	524	258	905	2958	2263	635	930	809	11363	6482	6764	1993	1675	3744	1575	5368	6390	860
4	1202	442	123	1304	1835	1347	500	595	409	1654	10578	4768	656	4201	923	734	1438	2731	4011
5	929	418	130	463	262	341	123	736	115	701	1085	8258	106	1264	696	213	1369	696	1276
6	319	195	86	422	79	61	46	291	70	247	490	1138	97	490	169	297	388	399	357
7	118	42	58	527	97	24	13	171	59	124	50	416	6	414	60	220	494	142	62
8	25	27	15	180	228	20	14	32	12	39	39	132	5	122	42	132	318	168	11
9	3	6	2	48	100	32	15	20	4	36	71	29	8	205	6	37	248	61	48
10	0	4	1	27	19	16	21	31	10	8	20	1	5	10	6	2	123	21	28
11	1	1	2	2	3	3	10	9	10	0	9	7	6	75	2	7	70	21	10
12	0	0	1	0	26	10	3	16	3	7	9	25	1	7	0	2	3	38	21
13	1	7	1	0	1	0	3	2	5	1	0	2	4	30	2	3	3	0	23
14	3	1	1	0	26	2	2	3	1	1	0	4	5	41	0	12	8	1	0
15	0	9	3	0	2	5	2	0	1	0	4	0	0	1	0	0	1	0	4
16	0	5	0	1	3	1	0	2	0	0	0	0	0	1	4	0	0	0	2
17	0	0	0	3	4	1	1	5	0	0	0	0	0	0	0	0	0	0	0
18	3	2	1	0	1	0	1	3	0	0	0	0	0	0	0	0	0	0	0
19	0	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
>19	0	2	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0

Table 6. Long Island Ocean Haul Seine Survey Striped Bass Mean Catch Per Haul by Age for 1987 - 2005. Data from Standard Hauls made Between 10/2 Through 11/29.

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2	3	15	5	4	75	7	7	13	113	37	154	155	8	27	6	96	56	21	72
3	12	14	6	26	66	65	17	29	18	284	158	218	66	40	104	43	206	156	21
4	34	12	3	37	41	38	14	19	9	41	258	154	22	100	26	20	55	67	100
5	27	11	3	13	6	10	3	23	3	18	26	266	4	30	19	6	53	17	32
6	9	5	2	12	2	2	1	9	2	6	12	37	3	12	5	8	15	10	9
7	3	1	1	15	2	1	0	5	1	3	1	13	0	10	2	6	19	3	2
8	1	1	0	5	5	1	0	1	0	1	1	4	0	3	1	4	12	4	0
9	0	0	0	1	2	1	0	1	0	1	2	1	0	5	0	1	10	1	1
10	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	5	1	1
11	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	1	0
12	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	1	1
13	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
14	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 7. 2005 Long Island Ocean Haul Seine Survey Mean Total Length (mm) of Striped Bass by Year Class.

Yearclass	Mean TL	STD	Min TL	Max TL	Sample N
2003	437	31	346	545	380
2002	509	45	388	637	104
2001	554	42	435	663	346
2000	614	56	481	747	119
1999	677	57	586	790	27
1998	750	65	620	864	14
1997	789	90	662	880	6
1996	814	100	630	930	9
1995	894	77	754	975	8
1994	841	106	711	1001	6
1993	965	89	902	1067	3
1992	1011	74	917	1076	4
1991	-	-	-	-	
1990	1054	222	897	1211	2
1989	1173	25	1155	1191	2

Table 8. Long Island Ocean Haul Seine Survey Mean Total Length of Striped Bass by Year Class 1987 - 2005.

Year Class	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2003																			437
2002																		438	509
2001																384	454	493	554
2000																440	507	567	614
1999														396	454	504	546	610	677
1998													421	435	517	582	635	672	750
1997													439	518	577	635	695	712	789
1996											391	417	484	582	625	705	744	797	814
1995										340	418	484	537	632	696	743	798	806	894
1994									329	419	480	559	601	682	753	788	812	863	841
1993								425	406	462	531	612	659	741	822	851	885	960	965
1992								469	498	541	600	664	762	796	902	865	913	954	1011
1991						325	455	518	589	623	693	720	804	842	946	887	969		
1990						438	504	577	643	673	764	797	907	893	946	1009	1027	1157	1054
1989					468	524	571	645	714	744	877	863	939	994	875	1029	986		1173
1988			323	454	526	586	658	719	827	825	926	950	987	986	975	964	880		
1987		317	443	541	587	652	718	782	840	813	922	949	972	1103	938				
1986	335	456	547	628	686	733	795	864	912	916	978	974	1060	1047					
1985	441	545	624	692	777	799	835	903	975	1062	935	996	1107	1145	1117				
1984	531	614	680	737	800	829	860	922	942	981		1085	1152	1211					
1983	617	679	735	799	836	871	904	968	998	1011					1134				
1982	677	737	790	839	879	926	933	964	1053	1112	1094								
1981	707	763	810	813	847	898	909	1075	1231										

Table 8, continued. Long Island Ocean Haul Seine Survey Mean Total Length of Striped Bass by Year Class 1987 - 2005.

Year Class	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1980	748	782	847	783	832	965	1119	1186	1215									
1979	719	821	831	932	990	975	1112	1153										
1978	829	840	1096		1050	1171	1145	1187										
1977		997	1105	790	1181	1145		1211										
1976	919		1120	1180	1174	1222	1241	1173										
1975		1138	1129		1190	1266	1182	1292										
1974	1095	1095	1130	1270	1201		1220											
1973	1150	1154		1186	1253													
1972		1221					1236											
1971		1275	1269															
1970		1217																
1969		1161			1272													

Table 9. 2005 Long Island Ocean Haul Seine Survey Mean Weight (Kg.) of Striped Bass by Year Class.

Yearclass	Mean Wt.	STD	Min Wt.	Max Wt.	Sample N
2003	0.86	0.18	0.42	1.54	380
2002	1.30	0.34	0.56	2.54	104
2001	1.64	0.37	0.76	2.92	346
2000	2.22	0.57	1.00	3.76	121
1999	2.97	0.78	1.94	4.80	27
1998	4.12	0.94	2.30	5.98	14
1997	4.99	1.77	2.74	7.10	6
1996	5.32	1.49	3.14	7.92	9
1995	6.71	1.61	4.38	9.46	8
1994	6.38	2.40	4.16	10.22	6
1993	8.43	1.85	7.24	10.56	3
1992	10.07	2.57	6.80	12.30	4
1991					
1990	13.42	10.21	6.20	20.64	2
1989	17.61	0.13	17.52	17.70	2

Table 10. Long Island Ocean Haul Seine Survey Mean Weight (Kg) of Striped Bass by Year Class 1987 - 2005.

Year Class	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2003																			0.9
2002																		0.9	1.3
2001																0.6	1.0	1.2	1.6
2000																0.9	1.4	1.8	2.2
1999														0.6	1.0	1.3	1.8	2.2	3.0
1998													0.8	0.9	1.3	2.0	2.8	3.0	4.1
1997													0.9	1.4	1.8	2.6	3.4	3.6	5.0
1996											0.8	0.7	1.2	2.0	2.3	3.4	4.2	4.9	5.3
1995										0.4	0.8	1.2	1.6	2.5	3.2	4.0	5.1	5.1	6.7
1994									0.4	0.8	1.1	1.7	2.2	3.2	4.0	4.7	5.7	6.4	6.4
1993								0.8	0.7	1.0	1.2	2.3	2.8	4.0	5.2	5.9	7.1	8.7	8.4
1992								1.2	1.3	1.6	2.2	2.9	4.3	5.4	7.0	6.5	8.0	8.6	10.1
1991						0.4	1.0	1.5	2.0	2.3	3.3	3.7	5.4	6.3	8.5	7.2	9.5		
1990						0.9	1.3	2.0	2.6	3.0	4.2	5.0	7.6	7.6	8.3	10.3	10.7	15.5	13.42
1989					1.1	1.5	1.9	2.8	3.6	4.1	6.7	7.2	8.2	11.2	7.0	10.8	10.1		17.6
1988			0.4	1.0	1.5	2.1	2.9	3.9	5.4	5.9	8.0	8.9	8.9	10.8	9.5	9.2	7.8		
1987		0.4	1.0	1.7	2.1	2.9	3.8	5.0	6.2	5.5	8.3	8.5	8.9	13.8	8.7				
1986	0.4	1.1	1.7	2.4	3.2	4.1	5.1	6.7	7.8	8.4	9.0	9.5	12.2	12.8					
1985	1.0	1.7	2.4	3.2	4.5	5.1	6.0	7.6	9.7	11.7	8.5	10.3	15.3	14.9	13.5				
1984	1.6	2.4	3.2	3.9	5.0	5.9	6.6	8.3	8.6	10.1		13.2	16.7	17.3					
1983	2.4	3.2	4.0	5.0	5.8	6.9	7.8	9.7	10.5	9.8					14.1				
1982	3.2	4.1	5.0	5.8	6.9	8.4	8.5	10.0	11.7	15.4	14.3								
1981	3.7	4.6	5.5	5.3	6.1	7.6	8.3	14.0	18.5										
1980	4.5	5.3	6.7	5.0	5.9	10.0	15.2	18.5	18.0										
1979	4.0	5.9	6.0	8.2	12.1	10.3	15.7	18.1											
1978	6.5	6.4	14.0		13.1	16.9	16.7	19.7											

Table 10, continued. Long Island Ocean Haul Seine Survey Mean Weight (Kg) of Striped Bass by Year Class 1987 - 2005.

Year Class	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1977		11.1	13.4	5.2	16.9	15.9		18.7											
1976	9.3		17.6	17.0	20.6	20.3	19.3	17.8											
1975		15.6	16.9		18.0	26.4	16.4	26.0											
1974	14.8	13.0	15.5	19.9	19.2		20.2												
1973	15.9	16.7		17.9	23.2														
1972		20.6					22.9												
1971		23.1	21.3																
1970		20.6																	
1969		18.3			22.0														

Table 11. 1987 - 2005 L.I. Ocean Haul Seine Survey Striped Bass Mean Total Length (mm) by Age.

Age	Mean TL	Std	LCLM	UCLM	Min	Max	N
1	341	40.7	332	350	272	451	83
2	436	39.6	435	438	301	617	5317
3	504	50.6	503	506	329	756	9627
4	580	57.3	579	582	367	842	6457
5	650	62.0	648	652	441	849	3579
6	714	69.0	710	717	500	1041	1732
7	773	72.9	769	778	486	990	982
8	823	80.9	816	829	567	1181	643
9	862	90.0	853	871	430	1061	406
10	901	98.3	889	913	640	1140	262
11	934	94.5	918	951	708	1140	133
12	961	87.3	942	981	774	1150	82
13	1043	94.7	1015	1071	790	1197	46
14	1102	87.3	1070	1134	936	1231	31
15	1131	85.3	1099	1162	880	1261	30
16	1192	43.6	1169	1216	1103	1270	16
17	1219	54.1	1189	1249	1126	1336	15
18	1199	40.5	1173	1225	1134	1269	12
19	1223	58.0	1131	1315	1161	1292	4
20	1245				1245	1245	1
21	1217	26.9	976	1458	1198	1236	2
22	1272	12.7	1158	1386	1263	1281	2

Table 12. 1987 - 2005 L.I. Ocean Haul Seine Survey Striped Bass Mean Weight (Kg.) by Age.

Age	Mean WT	Std	LCLM	UCLM	Min	Max	N
1	0.47	0.26	0.41	0.52	0.20	2.20	83
2	0.89	0.26	0.88	0.90	0.30	2.30	5317
3	1.34	0.40	1.33	1.34	0.34	3.35	9627
4	1.99	0.58	1.97	2.00	0.40	4.50	6457
5	2.77	0.80	2.75	2.80	0.88	7.50	3579
6	3.65	1.06	3.60	3.70	1.18	10.68	1732
7	4.64	1.29	4.56	4.72	1.04	9.70	982
8	5.64	1.69	5.51	5.77	1.60	17.84	643
9	6.61	1.99	6.41	6.80	0.90	13.40	406
10	7.64	2.49	7.34	7.95	2.80	16.14	262
11	8.51	2.58	8.07	8.96	3.60	16.80	133
12	9.58	2.72	8.98	10.18	5.02	15.98	82
13	12.01	3.46	10.98	13.04	4.78	19.34	46
14	14.56	3.34	13.34	15.78	8.56	20.02	31
15	16.03	3.47	14.74	17.33	6.20	25.16	30
16	18.30	2.42	17.01	19.59	12.90	22.00	16
17	19.87	3.35	18.02	21.73	14.58	26.44	15
18	18.84	2.54	17.22	20.45	14.12	23.18	12
19	21.16	3.46	15.66	26.66	18.30	25.96	4
20	19.90						1
21	19.64	4.65					2
22	22.04	3.59					2

Table 13. A. Mean Annual Growth Increments of Total Length (mm) by Age for Striped Bass from the Long Island Ocean Haul Seine Survey 1987 - 2005.

	Increment of mean total length (mm) between ages										
Y-Class	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
2002		71									
2001	70	39	61								
2000		66	60	47							
1999	58	50	42	64	67						
1998		82	65	52	35	78					
1997		79	59	58	60	17	77				
1996	26	67	90	43	80	39	53	17			
1995	78	66	53	95	64	47	55	8	88		
1994	90	61	79	42	81	71	35	24	51		
1993		56	69	81	47	82	81	28	34	75	
1992		29	43	59	64	98	34	106		48	41
1991	130	63	71	34	70	27	84	38	104		82
1990		66	73	66	30	91	33	110		53	63
1989		56	47	74	69	30	133		76	55	
1988	131	72	60	72	61	108		101	24	37	
1987	126	98	46	65	66	64	58		109	27	23
1986	121	91	81	59	46	62	69	48		62	
1985		104	79	68	85	22	36	68	72	87	
1984			83	66	57	63	29	31	62	20	39
1983				62	56	64	37	35	33	64	30
1982					60	54	48	40	48	6	31
1981						56	47	3	34	51	11
1980							34	65		49	133
1979								102	10	101	58
1978									11		
1977											108
Mean	92	68	65	62	61	60	55	52	54	53	56
Std	37	19	15	15	15	26	27	36	32	25	38

Table 13. B. Mean Annual Growth Increments of Weight (Kg.) by Age for Striped Bass from the Long Island Ocean Haul Seine Survey 1987 - 2005.

	Increment of mean weight (Kg.) between ages										
Y-Class	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
2002		0.42									
2001	0.42	0.17	0.44								
2000		0.52	0.37	0.44							
1999	0.29	0.35	0.48	0.46	0.75						
1998		0.45	0.66	0.79	0.20	1.17					
1997		0.52	0.37	0.77	0.87	0.19	1.36				
1996		0.42	0.82	0.31	1.07	0.80	0.70	0.46			
1995	0.35	0.40	0.41	0.89	0.69	0.81	1.18		1.63		
1994	0.34	0.35	0.63	0.48	1.02	0.82	0.68	0.99	0.66	0.02	
1993		0.29	0.48	1.12	0.55	1.18	1.19	0.75	1.18	1.62	
1992		0.10	0.34	0.57	0.69	1.41	1.09	1.62		1.52	0.58
1991	0.61	0.51	0.47	0.35	0.96	0.39	1.73	0.89	2.23		2.35
1990		0.43	0.72	0.50	0.44	1.20	0.84	2.55		0.73	2.00
1989		0.45	0.40	0.93	0.72	0.56	2.55	0.53	0.97	3.03	
1988	0.65	0.46	0.62	0.78	1.03	1.48	0.46	2.12	0.87	0.04	1.91
1987	0.62	0.67	0.42	0.85	0.83	1.23	1.19			0.14	0.43
1986	0.63	0.65	0.72	0.81	0.89	0.96	1.61	1.06		0.60	0.48
1985		0.68	0.74	0.78	1.26	0.65	0.87	1.56	2.18	1.96	
1984			0.74	0.82	0.70	1.13	0.91	0.61	1.70	0.35	1.50
1983				0.76	0.79	1.01	0.76	1.19	0.86	1.85	0.85
1982					0.91	0.94	0.83	1.06	1.47	0.15	1.45
1981						0.87	0.98		0.55	1.49	0.72
1980							0.77	1.48		0.98	4.06
1979								1.91		2.13	3.93
1978											
1977											2.3
Mean	0.49	0.44	0.55	0.69	0.80	0.93	1.09	1.25	1.30	1.11	1.74
Std	0.15	0.15	0.16	0.22	0.25	0.34	0.49	0.61	0.58	0.92	1.21

Table 14. Summary of Linear Regression Parameters for predicting Annual Log_e-weight from Log_e-total length from the 1987 - 2005 L.I. Ocean Haul Seine Survey.

Year	Slope		Intercept		R^2	Sample (N)
	Mean	S.E	Mean	S.E.		
1987	2.78	0.01	-16.96	0.08	0.96	1948
1988	2.88	0.008	-17.65	0.05	0.98	2098
1989	2.83	0.01	-17.31	0.07	0.98	1195
1990	2.79	0.01	-17.10	0.06	0.98	2042
1991	2.90	0.01	-17.80	0.06	0.98	1788
1992	2.96	0.01	-18.17	0.07	0.98	1605
1993	2.91	0.01	-17.85	0.05	0.98	2201
1994	2.89	0.01	-17.67	0.05	0.99	1709
1995	2.90	0.01	-17.81	0.04	0.99	1484
1996	2.95	0.01	-17.15	0.05	0.98	2198
1997	2.89	0.02	-17.75	0.12	0.93	1662
1998	2.94	0.01	-18.04	0.07	0.98	1577
1999	2.82	0.02	-17.30	0.09	0.96	1396
2000	2.87	0.01	-17.62	0.07	0.98	1507
2001	2.93	0.01	-18.07	0.08	0.98	1052
2002	2.86	0.01	-17.56	0.05	0.99	1155
2003	2.86	0.01	-17.47	0.08	0.98	818
2004	2.86	0.01	-17.55	0.08	0.97	1518
2005	2.86	0.01	-17.54	0.07	0.98	1036
87-05	2.92	0.002	-17.94	0.02	0.98	29,991

Table 15. 1987 - 2005 L.I. Ocean Haul Seine Survey Geometric Mean Catch Per Haul for select yearclasses of Striped Bass by Year.
Data from Standard Hauls made Between 10/2 Through 11/29.

Yearclass	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2004																			0.00
2003																		0.00	9.72
2002																	0.00	5.46	5.09
2001																0.15	11.51	62.09	16.41
2000															0.00	7.33	20.76	29.79	5.45
1999														0.02	1.49	5.14	7.12	6.84	1.34
1998													0.00	7.79	12.9	4.19	5.25	2.42	0.55
1997												0.00	1.97	11.8	4.19	1.83	2.31	0.83	0.14
1996											0.27	19.6	17.7	26.5	6.05	1.67	3.68	0.67	0.36
1995										0.07	20.2	31.0	4.87	9.43	2.09	1.30	2.88	0.39	0.26
1994									0.09	11.7	23.7	17.9	1.68	2.23	0.78	0.45	1.29	0.12	0.14
1993								0.06	3.20	105.	44.2	29.8	1.24	2.25	0.55	0.45	1.01	0.15	0.15
1992							0.00	2.22	3.52	16.1	6.56	3.82	0.14	0.25	0.09	0.03	0.72	0.19	0.14
1991						0.00	3.81	4.26	3.32	4.64	1.81	0.95	0.09	0.24	0.11	0.11	0.05	0.00	0.00
1990					0.00	1.49	9.43	2.46	0.94	1.33	0.36	0.61	0.13	0.10	0.03	0.04	0.07	0.02	0.05
1989				0.00	5.23	7.84	7.09	2.12	0.86	1.03	0.36	0.30	0.10	0.11	0.00	0.06	0.18	0.00	0.03
1988			0.11	1.89	9.26	4.85	1.71	1.31	0.46	0.38	0.38	0.02	0.11	0.06	0.03	0.07	0.03	0.00	0.00
1987		0.49	1.86	9.19	6.16	2.28	0.80	0.86	0.16	0.19	0.17	0.10	0.02	0.10	0.00	0.00	0.00		

Table 16. Catch Curve Estimates of Total Annual Mortality by Year-class for Striped Bass from the 1987 - 2005 L.I. Ocean Haul Seine Survey, Based on Mean Catch per Haul as Underlined in Table 15.

Year-Class	Z	s.e. (Z)	T for H_0: Z = 0	Pr > |T|	Age Span	Year Span
1980	-0.356	0.100	-3.58	0.0005	7 - 15	1987 - 1995
1981	-0.552	0.100	-5.55	<0.0001	6 - 14	1987 - 1995
1982	-0.512	0.074	-6.97	<0.0001	5 - 15	1987 - 1997
1983	-0.640	0.085	-7.54	<0.0001	4 - 13	1987 - 1996
1984	-0.441	0.058	-7.63	<0.0001	3 - 16	1987 - 2000
1985	-0.379	0.051	-7.37	<0.0001	3 - 16	1988 - 2001
1986	-0.389	0.074	-5.28	<0.0001	4 - 14	1990 - 2000
1987	-0.541	0.074	-7.36	<0.0001	3 - 13	1990 - 2000
1988	-0.477	0.057	-8.34	<0.0001	3 - 17	1991 - 2005
1989	-0.412	0.057	-7.28	<0.0001	3 - 16	1992 - 2005
1990	-0.457	0.057	-7.99	<0.0001	3 - 15	1993 - 2005
1991	-0.551	0.085	-6.49	<0.0001	3 - 14	1994 - 2005
1992	-0.494	0.085	-5.82	<0.0001	4 - 13	1996 - 2005
1993	-0.728	0.085	-8.58	<0.0001	3 - 12	1996 - 2005
1994	-0.628	0.100	-6.31	<0.0001	3 - 11	1997 - 2005
1995	-0.597	0.119	-5.01	<0.0001	3 - 10	1998 - 2005
1996	-0.780	0.184	-4.23	<0.0001	4 - 9	2000 - 2005
1997	-0.766	0.184	-4.15	<0.0001	3 - 8	2000 - 2005
1998	-0.686	0.244	-2.81	0.0055	3 - 7	2001 - 2005

Table 17. Total Length and Age Frequencies of Striped Bass Tagged During the 2005 Long Island Ocean Haul Seine Survey. Total Number of Striped Bass Tagged = 986.

TL	Frequency	% Frequency		Age	Y-Class	Frequency	% Frequency
249	0	0.00		1	2004	0	0.00
299	0	0.00		2	2003	375	38.11
349	1	0.10		3	2002	100	10.16
399	37	3.75		4	2001	324	32.93
449	226	22.92		5	2000	111	11.28
499	179	18.15		6	1999	23	2.34
549	181	18.36		7	1998	14	1.42
599	171	17.34		8	1997	6	0.61
649	90	9.13		9	1996	8	0.81
699	43	4.36		10	1995	7	0.71
749	14	1.42		11	1994	6	0.61
799	14	1.42		12	1993	3	0.30
849	4	0.41		13	1992	4	0.41
899	7	0.71		14	1991	0	0.00
949	10	1.01		15	1990	1	0.10
999	2	0.20		16	1989	2	0.20
1049	1	0.10		17	1988	0	0.00
1099	3	0.30		18	1987	0	0.00
>1099	3	0.30		19	1986	0	0.00
Total	986				Total	984*	

* - Age not determined for 2 samples.

Table 18. Releases of Striped Bass Tagged in the Long Island Ocean Haul Seine Survey from 1987 to 2005 with Recaptures through May of 2006. Recovery years run from December of the year of tagging through November of the following calendar year. 26 fish were recaptured before start of first recovery year in 1987.

		Recovery Years																				
Year	**N**	**1**	**2**	**3**	**4**	**5**	**6**	7	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**All**	**%**
1987	1741	132	72	62	40	25	24	12	13	5	3	3	4	1	0	1	1	0	0	0	398	0.23
1988	1870	31	183	117	78	37	43	24	16	6	6	6	3	3	2	0	0	1	0	0	556	0.30
1989	947		10	84	41	25	14	7	2	8	3	3	1	0	1	0	1	0	0	0	200	0.21
1990	1118			18	82	53	41	17	22	16	15	9	3	2	3	2	1	1	0	1	286	0.26
1991	1093				15	89	46	25	27	15	10	13	4	2	1	1	1	3	0	1	253	0.23
1992	1376					21	83	33	27	24	17	6	7	6	2	1	1	1	1	0	230	0.17
1993	1920						41	137	62	62	52	22	28	7	8	4	3	2	2	0	430	0.22
1994	1611							25	103	88	59	39	17	11	7	10	7	5	1	0	372	0.23
1995	1385								11	106	31	33	17	9	3	4	1	3	1	0	219	0.16
1996	1905									35	125	44	24	16	9	4	5	7	4	1	274	0.14
1997	1691										6	110	37	16	16	14	11	1	3	0	214	0.13
1998	1547											8	90	44	40	20	10	10	5	1	228	0.15
1999	1352												10	78	30	26	21	9	4	3	181	0.13
2000	1485													7	88	49	30	23	7	4	208	0.14
2001	1027														3	80	32	18	5	6	144	0.14
2002	1188														1	4	58	25	28	6	122	0.10
2003	801																	49	20	2	71	0.09
2004	1443																	7	89	13	109	0.08
2005	986																		8	31	39	0.04
Total	26486	163	265	281	256	250	292	280	283	365	327	296	245	202	214	220	183	165	178	69	4534	0.17

Table 19. Releases of Striped Bass >= 28 inches Total Length Tagged in the Long Island Ocean Haul Seine Survey from 1987 to 2005 with Recaptures through May of 2006. Recovery years run from December of the year of tagging through November of the following calendar year. 8 fish were recaptured before start of first recovery year in 1987.

		Recovery Years																				
Year	**N**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**All**	**%**
1987	222	25	14	14	9	5	6	1	3	1	1	0	2	0	0	0	0	0	0	0	81	0.36
1988	347	5	35	28	24	14	13	7	4	1	1	2	0	0	2	0	0	0	0	0	136	0.39
1989	249		3	23	17	10	6	3	0	2	1	2	0	0	0	0	0	0	0	0	67	0.27
1990	287			6	30	25	10	6	5	2	6	3	0	1	1	0	0	0	0	0	95	0.33
1991	292				5	41	24	14	17	6	3	6	0	1	1	0	0	1	0	0	119	0.41
1992	244					8	28	13	13	7	6	0	1	0	0	0	0	0	0	0	76	0.31
1993	267						13	24	20	20	20	6	5	1	3	2	1	0	0	0	115	0.43
1994	369							16	53	37	22	18	6	4	3	1	4	3	0	0	167	0.45
1995	112								2	15	5	14	5	1	0	0	1	1	1	0	45	0.40
1996	76									6	13	5	4	0	1	2	1	1	1	1	35	0.46
1997	83										1	6	4	3	1	1	1	0	0	0	17	0.20
1998	88											3	13	7	3	1	1	4	1	0	33	0.38
1999	57												1	8	6	2	4	2	0	0	23	0.40
2000	94													1	8	6	5	8	1	0	29	0.31
2001	176															29	11	5	0	1	46	0.26
2002	146															1	13	5	7	0	26	0.18
2003	154																	17	4	0	21	0.14
2004	66																	2	9	0	11	0.17
2005	57																			3	3	0.05
Total	3386	30	52	71	85	103	100	84	117	97	79	65	41	27	29	45	42	49	24	5	1145	0.34

Table 20. Distribution of Recoveries by Recovery Year Summarized by Gear, State, Type of Recapturing Fisherman and Disposition of All Fish after Capture.

Gear	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	all	%
H&L	124	217	236	216	203	230	255	250	291	303	271	223	179	187	205	174	152	168	62	3946	89.0
Gillnet	8	26	30	15	15	17	4	8	18	11	6	5	6	11	10	4	3	3	1	201	4.5
Trap	3	8	4	10	5	16	6	6	12	0	4	3	2	0	1	0	1	3	2	86	1.9
Trawl	2	2	2	4	1	1	0	1	1	4	5	0	2	2	0	1	3	0	2	33	0.7
Seine	21	9	3	5	11	11	2	7	26	0	1	0	1	1	0	1	0	0	0	99	2.2
Other	0	1	6	2	9	8	1	3	8	3	4	4	4	5	1	1	2	1	1	64	1.4

State	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	all	%
NS	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.02
ME	1	7	9	12	9	13	7	6	6	8	4	4	16	10	13	7	3	5	0	140	3.09
NH	2	2	1	1	6	3	7	4	4	5	5	2	3	3	7	2	5	2	0	64	1.41
MA	25	54	72	57	52	48	46	48	57	71	57	51	40	43	40	42	36	31	4	874	19.27
RI	5	26	21	22	25	16	19	16	34	27	19	14	13	11	23	11	15	15	3	335	7.39
CT	9	12	11	13	12	17	16	22	12	22	23	14	13	16	13	13	10	18	3	269	5.93
NY	98	119	120	88	108	135	123	114	166	123	93	79	57	61	69	57	50	58	21	1739	38.35
NJ	18	39	32	46	21	36	43	48	55	41	62	45	38	40	36	37	20	32	21	710	15.66
DE	1	2	11	3	2	8	3	6	5	4	3	4	3	4	5	1	3	2	4	74	1.63
MD	1	3	0	8	3	7	3	6	7	5	12	10	4	8	3	4	6	6	4	100	2.20
DC	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.02
VA	2	0	4	2	2	6	8	4	10	10	9	13	12	11	6	5	10	3	3	120	2.65
NC	1	1	1	1	3	0	0	2	0	4	2	2	0	2	1	2	7	4	5	38	0.84
UNK	0	0	0	2	7	2	5	7	9	7	11	7	3	5	4	1	0	0	0	70	1.54

Table 20. Continued...

Recapturing Fisherman Type

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	all	%
Sport	120	214	229	208	202	226	256	253	286	273	245	195	159	156	170	148	131	144	55	3670	80.31
Commerce	17	38	41	35	25	49	15	16	41	29	22	22	16	20	15	7	5	12	4	429	9.39
Research	22	10	8	8	16	12	3	9	27	2	6	0	3	6	0	3	3	1	2	141	3.09
Charter									1	22	24	22	20	26	32	23	23	21	7	221	4.84
Market				1	3	2	4	2	6	7	8	9	3	6	4	0				55	1.20
Other	3	1	3	4	0	2	1	4	10	1	3	5	3	6	3	2	2	0	1	54	1.18

Disposition

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	all	%
Released	147	243	223	176	173	177	194	154	216	184	170	121	118	109	113	79	79	115	41	2832	63.3
Killed	3	11	40	66	50	94	69	109	112	118	107	98	69	82	92	98	76	56	26	1376	30.8
Acc. Dead	4	3	4	2	4	0	4	1	5	2	1	1	1	2	1	0	1	0	0	36	0.8
Found Dead	3	2	1	4	1	3	1	0	0	1	0	2	1	2	0	0	2	0	0	23	0.5
Sold	0	1	1	6	13	12	6	13	18	19	17	19	9	13	10	5	5	7	1	175	3.9
Research	0	0	1	0	0	1	0	1	1	0	1	0	0	1	0	0	0	0	0	6	0.1
Found Tag	0	0	0	0	0	0	0	0	0	1	3	4	4	5	3	1	2	0	1	24	0.5

Proportion Released Alive

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
P_{REL}	0.94	0.93	0.82	0.69	0.72	0.62	0.71	0.55	0.61	0.57	0.57	0.49	0.58	0.51	0.52	0.43	0.48	0.65	0.59

Table 21. Individual Model Diagnostic Results from the Analysis of Tag Recoveries for All Striped Bass Tagged and Recovered in the 1987- 2005 L.I. Ocean Haul Seine Survey. Models Arranged by Delta QAICc Value. Model Selection Based on C-hat = 1.80.

Model	Delta QAICc	QAICc Weight	#Parameters	QDeviance
S(t)r(t)	0.00	1.00000	35	124.000
S(p)r(t)	36.29	0.00000	22	186.350
S(t)(p)	36.86	0.00000	22	186.915
S(p)r(p)	45.14	0.00000	8	223.230
S(v)r(p)	45.83	0.00000	9	221.926
S(d)r(p)	47.06	0.00000	9	223.153
S(.)r(t)	50.99	0.00000	19	207.060
S(.)r(p)	56.86	0.00000	5	240.960
S(.)r(.)	158.17	0.00000	2	348.265

Table 22. Model Weighted Average Survival Estimates by Year and Approximate 95% Confidence Limits for All Fish Tagged and Recovered in the 1987 - 2005 L.I. Ocean Haul Seine Survey.

Year	Survival	LCL	UCL
1988	0.550	0.454	0.642
1989	0.908	0.892	0.923
1990	0.551	0.446	0.651
1991	0.755	0.582	0.872
1992	0.932	0.917	0.944
1993	0.491	0.401	0.582
1994	0.682	0.558	0.785
1995	0.938	0.925	0.948
1996	0.779	0.579	0.900
1997	0.607	0.449	0.745
1998	0.493	0.369	0.617
1999	0.690	0.482	0.842
2000	0.594	0.426	0.743
2001	0.613	0.426	0.771
2002	0.742	0.432	0.916
2003	0.525	0.314	0.727
2004	0.471	0.265	0.687
2005	0.564	0.447	0.675

Table 23. Individual Model Diagnostic Results from the Analysis of Tag Recoveries for Striped Bass >=28 in. Total Length Tagged and Recovered in the 1987- 2005 L.I. Ocean Haul Seine Survey. Models Arranged by Delta QAICc Value. Model Selection Based on C-hat = 1.09.

Model	Delta QAICc	QAICc Weight	#Parameters	QDeviance
S(d)r(p)	0.00	0.76179	9	180.506
S(p)r(p)	3.05	0.16563	8	185.569
S(v)r(p)	5.00	0.06248	9	185.508
S(.)r(p)	9.35	0.00711	5	197.892
S(t)r(t)	11.61	0.00230	35	139.385
S(p)r(t)	15.12	0.00040	22	169.363
S(t)r(p)	15.92	0.00027	22	170.165
S(.)r(.)	20.33	0.00003	2	214.885
S(.)r(t)	24.23	0.00000	19	184.557

Table 24. Model Weighted Average Survival Estimates by Year and Approximate 95% Confidence Levels for Striped Bass >= 28 in. Total Length Tagged and Recovered in the 1987 - 2005 L.I. Ocean Haul Seine Survey.

Year	Survival	LCL	UCL
1988	0.812	0.686	0.895
1989	0.812	0.687	0.895
1990	0.627	0.593	0.660
1991	0.627	0.591	0.661
1992	0.628	0.588	0.666
1993	0.627	0.589	0.663
1994	0.627	0.593	0.661
1995	0.655	0.613	0.694
1996	0.655	0.612	0.695
1997	0.655	0.611	0.697
1998	0.654	0.605	0.700
1999	0.654	0.612	0.694
2000	0.707	0.612	0.787
2001	0.707	0.611	0.787
2002	0.707	0.610	0.788
2003	0.706	0.610	0.787
2004	0.706	0.592	0.800
2005	0.793	0.595	0.910

Table 25. Survival and Fishing Mortality Estimates Adjusted for Live Release Bias. Group refers to the subset of tagged fish, $\hat{S}$ is the Weighted Survival Estimate from Program MARK; f is the recovery rate estimated from a fully time specified Brownie type model {S(t)f(t)} ; Pl is the Proportion Released Alive;"bias" refers to the relative bias, and S adj and F adj are the Bias-Adjusted Survival and Fishing Mortality Rates, Respectively.

Group	Year	$\hat{S}$	f	Pl	bias	S adj	F adj
All Fish	1988	0.550	0.077	0.94	-0.159	0.654	0.28
All Fish	1989	0.908	0.092	0.93	-0.189	1.120	ERR
All Fish	1990	0.551	0.073	0.83	-0.135	0.637	0.30
All Fish	1991	0.755	0.080	0.69	-0.127	0.865	0.00
All Fish	1992	0.932	0.069	0.72	-0.113	1.050	ERR
All Fish	1993	0.491	0.055	0.62	-0.077	0.532	0.48
All Fish	1994	0.682	0.063	0.71	-0.100	0.758	0.13
All Fish	1995	0.938	0.063	0.55	-0.080	1.020	ERR
All Fish	1996	0.779	0.058	0.61	-0.081	0.847	0.02
All Fish	1997	0.607	0.052	0.57	-0.065	0.651	0.28
All Fish	1998	0.493	0.053	0.57	-0.070	0.529	0.49
All Fish	1999	0.690	0.056	0.49	-0.064	0.737	0.16
All Fish	2000	0.594	0.046	0.58	-0.062	0.632	0.31
All Fish	2001	0.613	0.053	0.51	-0.062	0.653	0.28
All Fish	2002	0.742	0.062	0.52	-0.078	0.802	0.07
All Fish	2003	0.525	0.049	0.43	-0.043	0.551	0.45
All Fish	2004	0.471	0.057	0.48	-0.060	0.503	0.54
All Fish	2005	0.564	0.062	0.65	-0.090	0.621	0.33

Table 26. Survival and Fishing Mortality Estimates Adjusted for Live Release Bias. Group refers to the subset of tagged fish, $\hat{S}$ is the Weighted Survival Estimate from Program MARK; f is the recovery rate estimated from a fully time specified Brownie type model {S(t)f(t)} ; Pl is the Proportion Released Alive; "bias" refers to the relative bias, and S adj and F adj are the Bias-Adjusted Survival and Fishing Mortality Rates, Respectively.

Group	Year	$\hat{S}$	f	Pl	bias	S adj	F adj
>=28 TL	1988	0.812	0.117	0.90	-0.24	1.062	ERR
>=28 TL	1989	0.812	0.101	0.86	-0.19	1.008	ERR
>=28 TL	1990	0.627	0.088	0.66	-0.14	0.725	0.17
>=28 TL	1991	0.627	0.112	0.53	-0.15	0.735	0.16
>=28 TL	1992	0.628	0.145	0.54	-0.20	0.787	0.09
>=28 TL	1993	0.627	0.108	0.43	-0.12	0.709	0.19
>=28 TL	1994	0.627	0.110	0.49	-0.13	0.725	0.17
>=28 TL	1995	0.655	0.149	0.34	-0.14	0.763	0.12
>=28 TL	1996	0.655	0.137	0.30	-0.11	0.739	0.15
>=28 TL	1997	0.655	0.151	0.21	-0.09	0.723	0.17
>=28 TL	1998	0.654	0.103	0.19	-0.05	0.690	0.22
>=28 TL	1999	0.654	0.138	0.10	-0.04	0.683	0.23
>=28 TL	2000	0.707	0.122	0.22	-0.07	0.763	0.12
>=28 TL	2001	0.707	0.102	0.24	-0.06	0.755	0.13
>=28 TL	2002	0.707	0.110	0.40	-0.11	0.796	0.08
>=28 TL	2003	0.706	0.087	0.21	-0.05	0.741	0.15
>=28 TL	2004	0.706	0.103	0.35	-0.09	0.778	0.10
>=28 TL	2005	0.793	0.141	0.17	-0.07	0.854	0.01

Table 27. Total Length Frequency of Magnetic Coded Wire Tag Recaptures from the 1991-2001 L.I. Ocean Haul Seine Survey.

TL	1991	1992	1993	1994	1995	1996	1997	1998	1999	2001
349	0	0	0	0	0	0	0	0	0	0
399	0	0	0	0	4	1	0	0	0	0
449	3	1	2	1	4	5	0	0	0	0
499	10	5	10	4	1	8	3	0	0	0
549	16	6	9	11	7	3	3	0	0	0
599	17	14	5	4	5	0	0	0	0	0
649	11	9	5	3	3	1	0	0	2	0
699	6	1	5	2	1	4	0	3	0	0
749	2	2	3	5	1	0	0	1	0	0
799	3	1	3	3	2	0	1	1	1	0
849	0	0	2	0	0	0	0	0	0	0
899	0	0	1	0	0	0	1	1	0	0
949	0	0	0	0	2	0	0	0	0	1
999	0	0	1	0	0	1	1	0	1	0
1049	0	0	0	0	1	0	1	0	1	0
>1049	0	0	0	0	0	0	0	0	0	0
Total	64	38	46	33	31	23	10	6	5	1

Table 28. Year-class Frequency of Magnetic Coded Wire Tag Recaptures from the 1991-2001 L.I. Ocean Haul Seine Survey. Year Class as Determined from Extracted Wire Tags.

Y-Class	1991	1992	1993	1994	1995	1996	1997	1998	1999	2001
1995	-	-	-	-	-	0	0	0	1	0
1994	-	-	-	-	-	4	1	0	1	0
1993	-	-	-	0	4	8	5	1	0	0
1992	-	-	0	4	15	8	0	2	1	0
1991	0	0	6	7	5	1	0	1	0	0
1990	0	2	15	7	1	0	0	0	0	1
1989	11	12	8	7	1	1	2	1	1	0
1988	21	19	8	7	2	0	1	0	1	0
1987	20	4	4	1	0	0	0	0	0	0
1986	10	2	4	0	2	0	1	0	0	0
1985	1	0	1	0	1	0	0	0	0	0
1984	0	0	0	0	0	1	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0
Total	63	39	46	33	31	23	10	5	5	1

Table 29. Origin of Coded Wire Tag Recaptures from the 1991 Through 2001 L.I. Ocean Haul Seine Survey.

River of Origin	1991	1992	1993	1994	1995	1996	1997	1998	1999	2001	Total
Hudson River	1	2	1	0	1	4	1	0	1	0	11
Choptank River	8	9	7	4	3	0	1	1	1	0	34
C&D Canal	2	0	0	0	0	0	0	0	0	0	2
Nanticoke River	2	0	2	1	16	7	4	1	1	0	34
Patuxent River	39	14	24	21	10	12	1	3	2	1	127
Upper Chesapeake Bay	11	14	12	7	1	0	2	0	0	0	47
Mattaponi	0	0	0	0	0	0	1	0	0	0	1
Total	63	39	46	33	31	23	10	5	5	1	256

Hatchery of Origin	1991	1992	1993	1994	1995	1996	1997	1998	1999	2001	Total
Attleboro	0	1	1	0	1	0	0	0	0	0	3
BG&E	4	1	3	0	1	0	0	0	0	0	9
Bowden	3	2	3	2	2	4	0	0	0	0	16
Edenton	6	6	3	6	5	4	2	1	1	0	34
Harrison Lake	5	4	5	0	3	0	0	0	0	0	17
Leetown	0	0	0	0	3	1	0	2	0	0	6
Lamar	0	0	1	1	5	1	1	1	0	0	10
Manning	4	1	2	0	1	0	0	0	0	0	8
McKinney Lake	0	0	2	0	0	0	1	0	0	0	3
Pepco	26	10	18	18	10	9	3	1	3	1	99
Senecaville	14	12	7	6	0	0	2	0	0	0	41
Verplank (Hudson)	1	2	1	0	0	4	1	0	1	0	10
Total	63	39	46	33	31	23	10	5	5	1	256

Table 30. Comparison of Assigned Ages by Scale Method Versus Known Ages of Extracted Coded Wire Tags from Hatchery Recaptures.

	Frequency Distribution				Under (-)/ Over (+) Ageing			
Age	CWT	Scale	#Correct	#Errors	-3	-2	-1	+1
2	31	33	31	0				
3	78	81	75	3			1	2
4	72	71	62	10		1	5	4
5	33	30	24	9			7	2
6	18	22	15	3	1		2	
7	10	6	6	4			4	
8	3	3	2	1		1		
9	4	3	3	1			1	
10	1	3	1	0				
11	4	2	2	2			2	
12	1	1	1	0				
Total	255		222	33	1	2	22	8

ACKNOWLEDGMENTS

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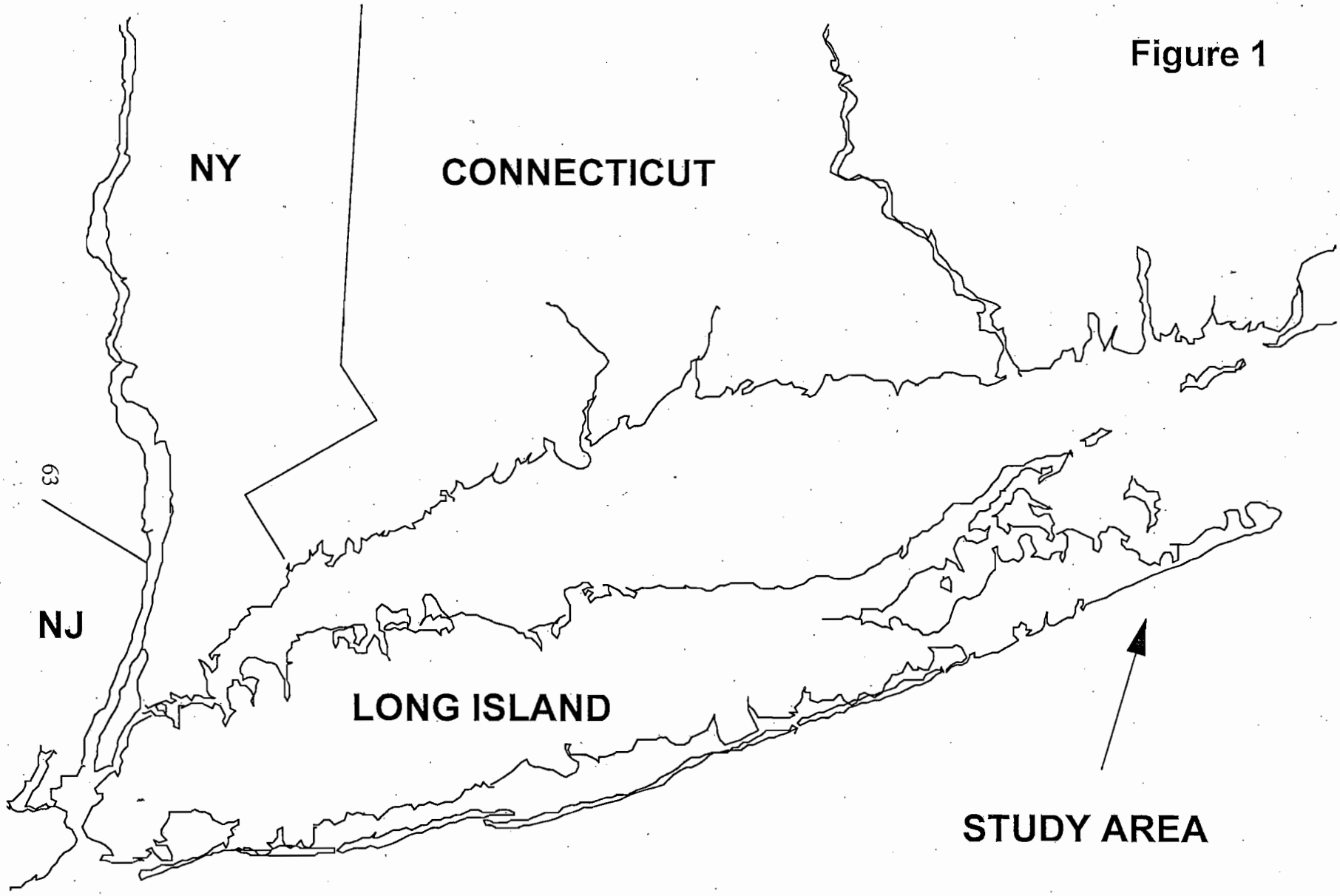
Figure 1
NY
CONNECTICUT
63
NJ
LONG ISLAND
STUDY AREA

1987 - 2005 L.I. OCEAN HAUL SEINE SURVEY

STRIPED BASS GEOMETRIC MEAN C.P.U.E.

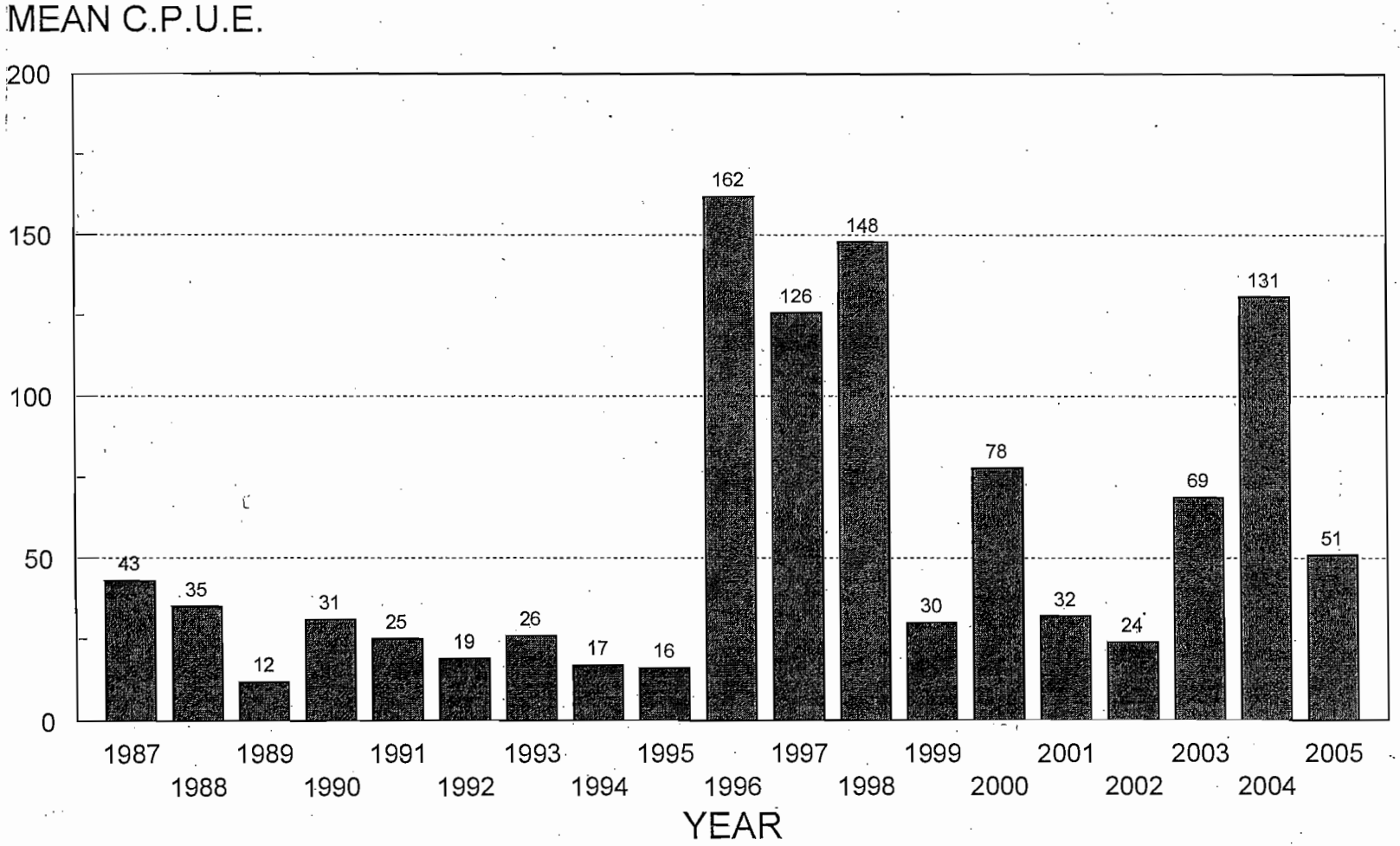

Figure 2

These data standardized by time, see text for details.

1987 & 2005 L.I. OCEAN HAUL SEINE SURVEY

TOTAL LENGTH FREQUENCIES

DATE STANDARD DATES (10/2 - 11/29)

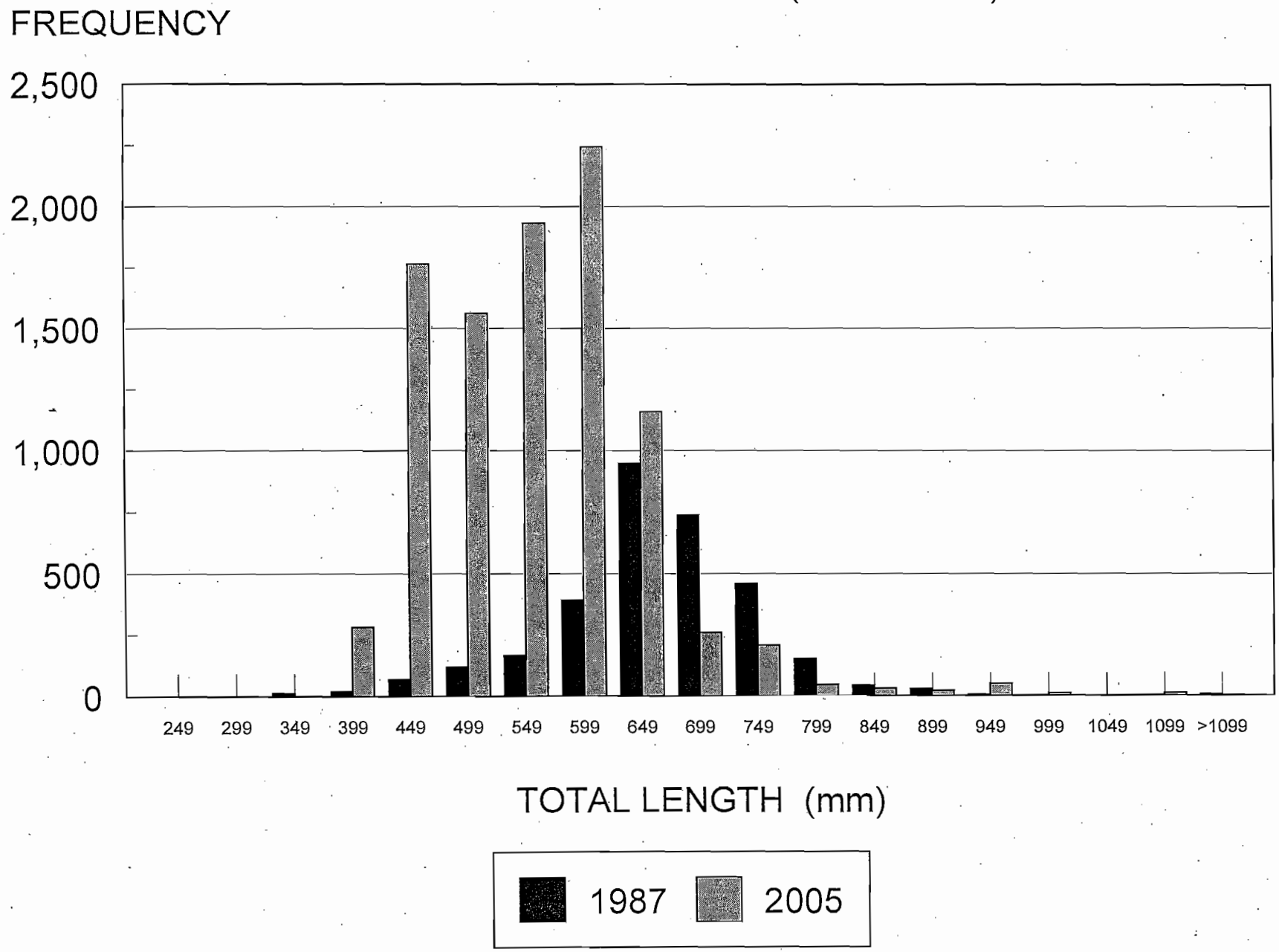

Figure 3

1987 & 2005 L.I. OCEAN HAUL SEINE SURVEY

AGE FREQUENCIES

DATE STANDARD DATA (10/2 - 11/29)

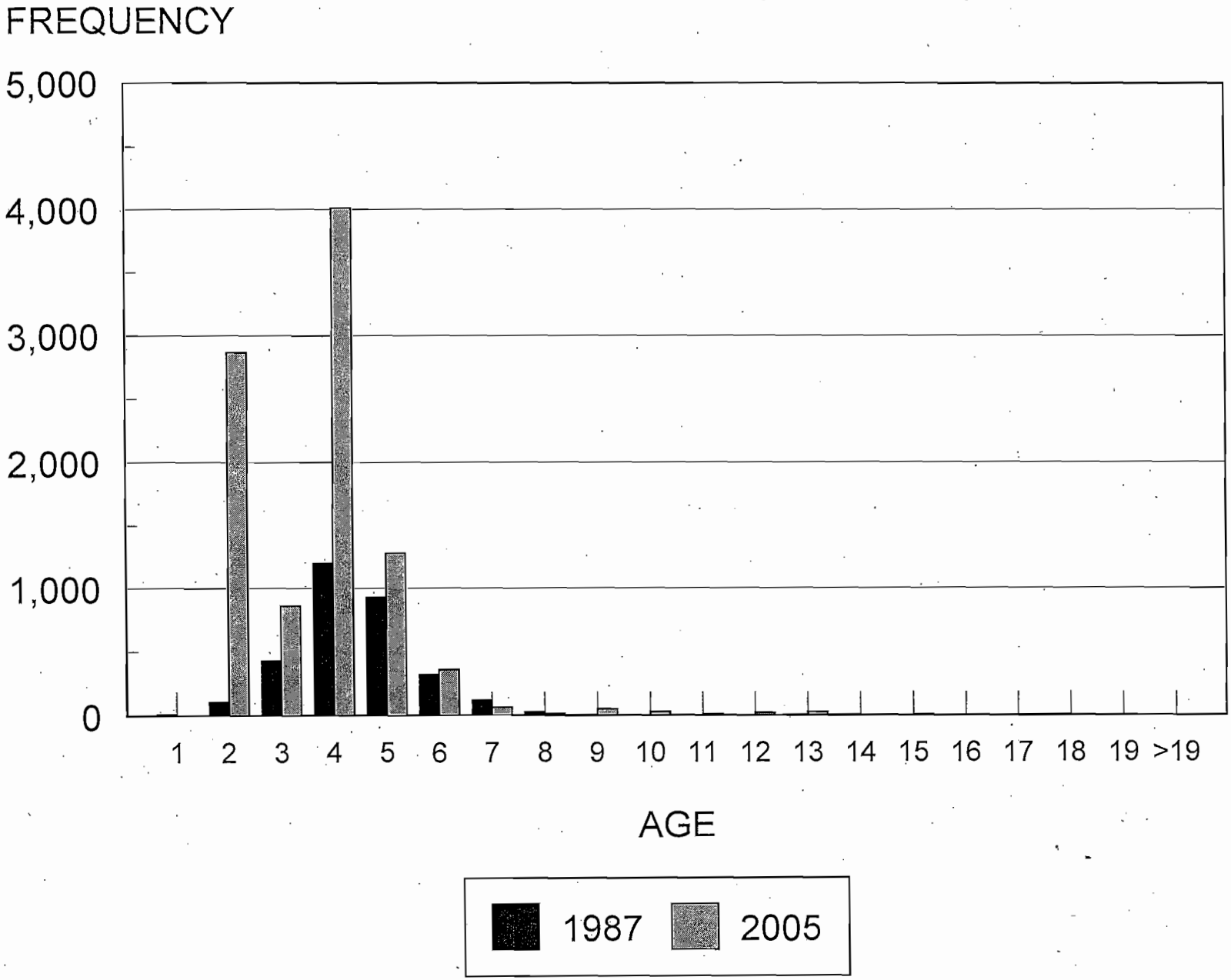

Figure 4

2005 L.I. OCEAN HAUL SEINE SURVEY

STRIPED BASS MEAN TOTAL LENGTH AT AGE

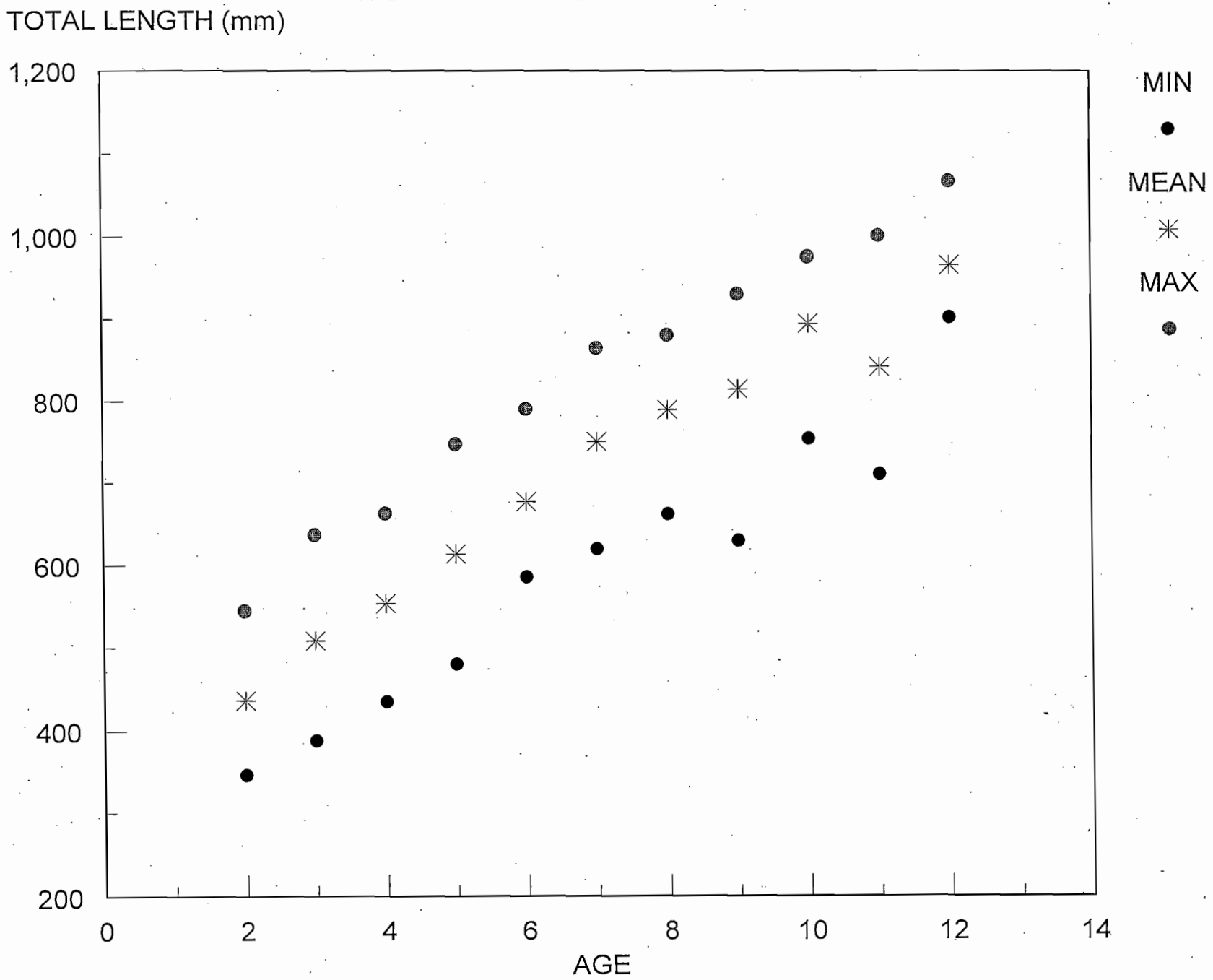

Figure 5

2005 L.I. OCEAN HAUL SEINE SURVEY

STRIPED BASS MEAN WEIGHT AT AGE

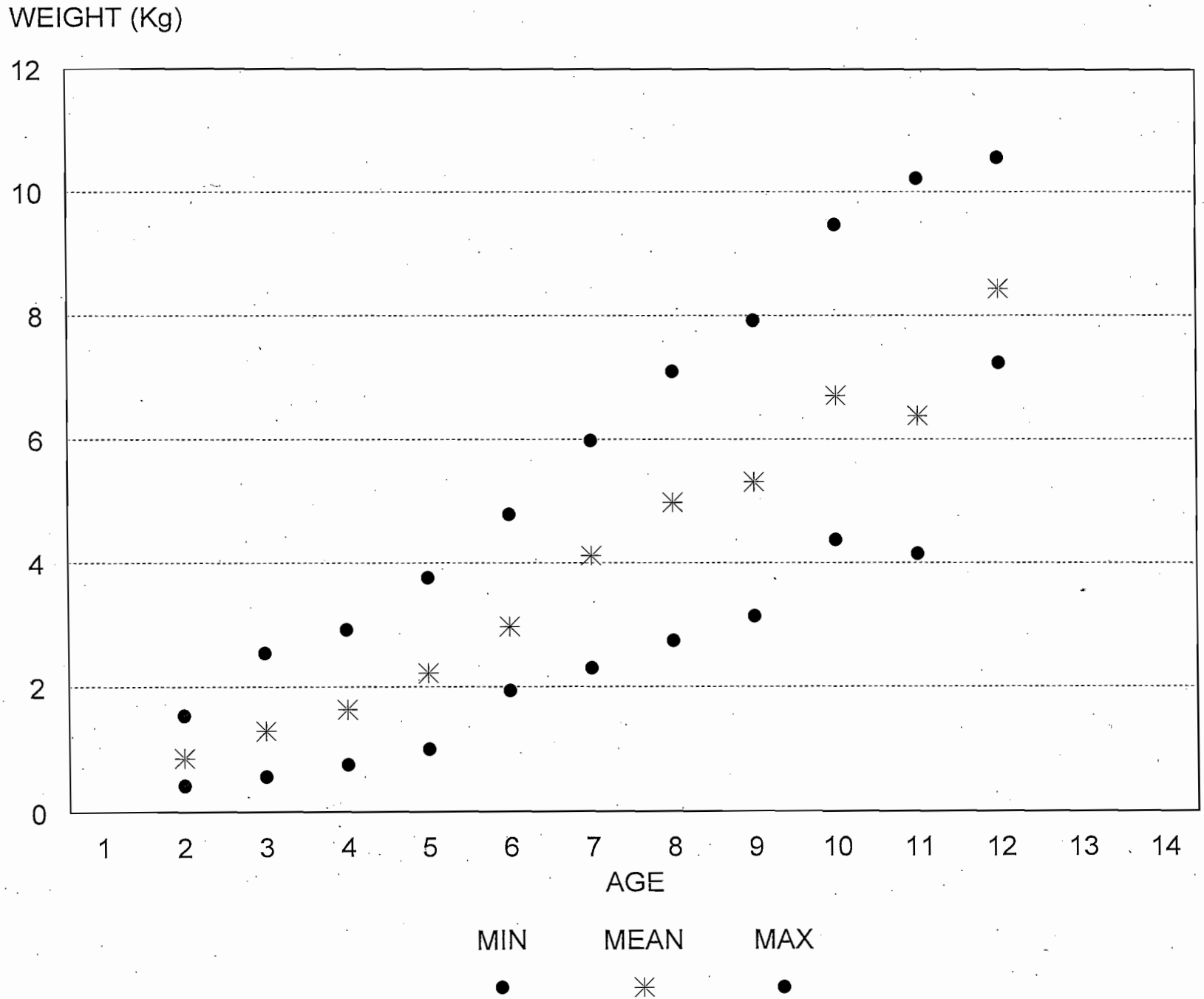

Figure 6

1987 - 2005 L.I. OCEAN HAUL SEINE SURVEY

STRIPED BASS MEAN TOTAL LENGTH AND WEIGHT AT AGE

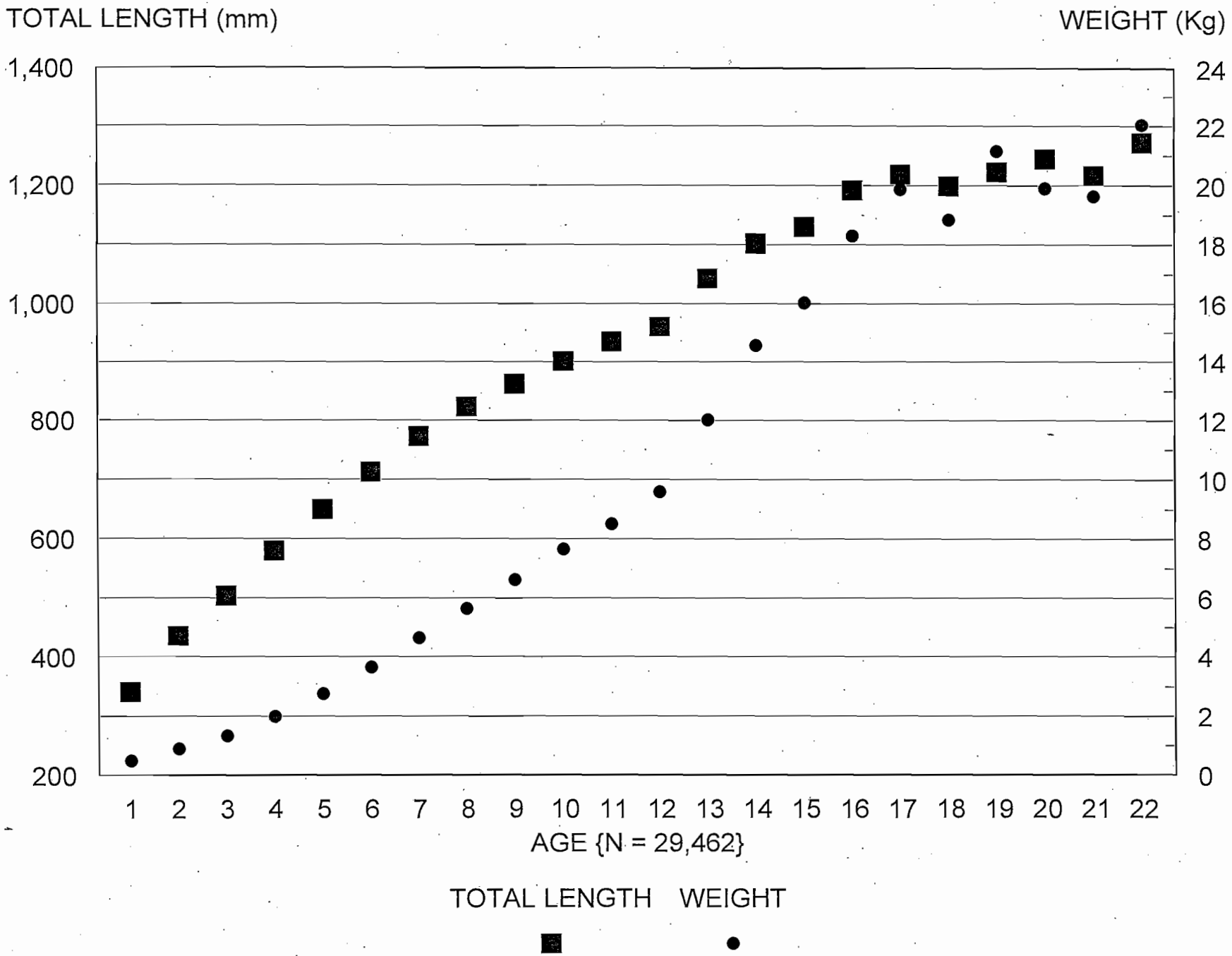

Figure 7

1987 - 2005 L.I. OCEAN HAUL SEINE SURVEY

MEAN GROWTH INCREMENT IN TOTAL LENGTH AND WEIGHT

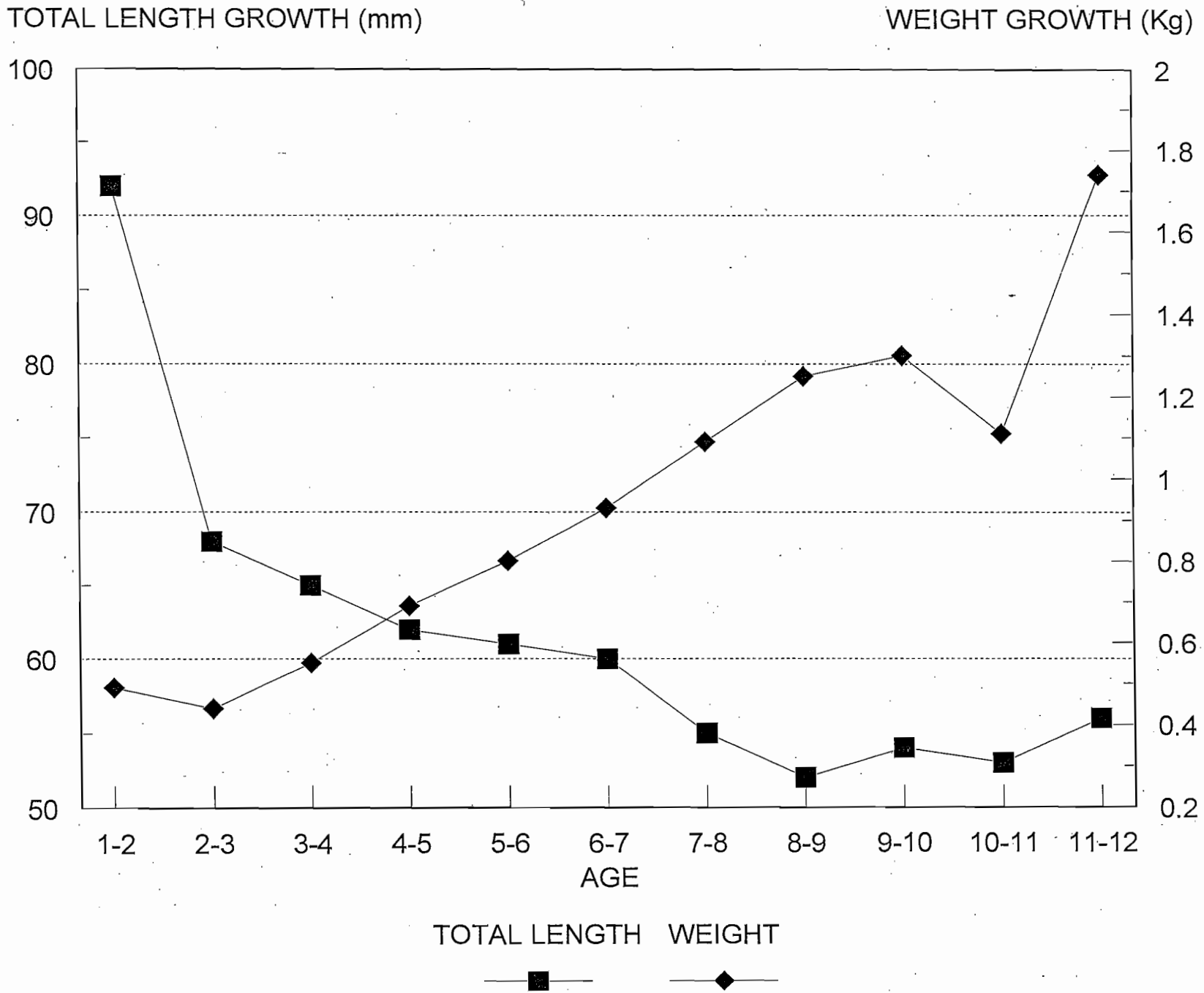

Figure 8

1991 - 2001 L.I. OCEAN HAUL SEINE SURVEY

AGREEMENT BETWEEN SCALE AND CWT AGES

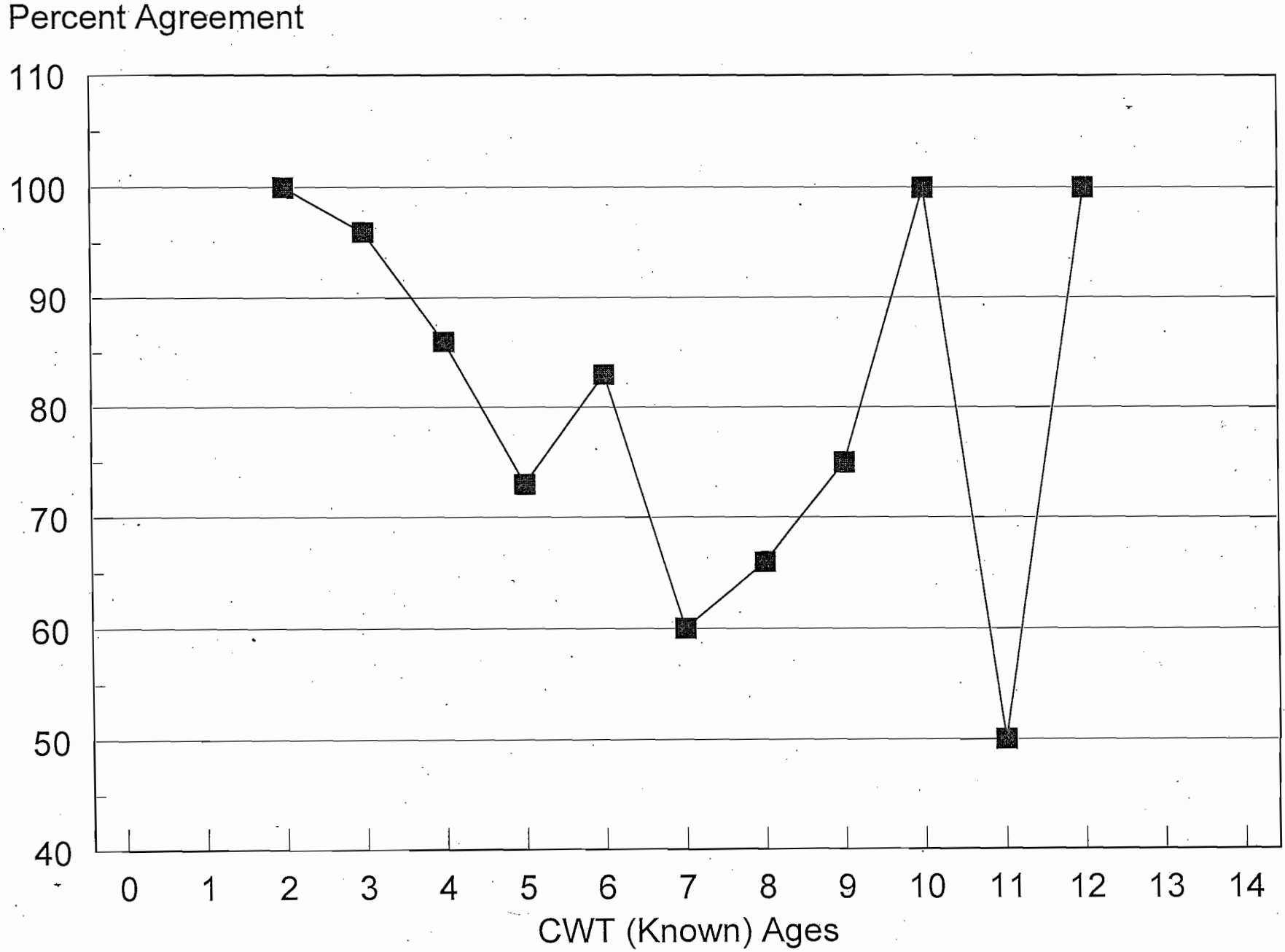

Figure 9